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COMPILATION, DESIGN TESTS ARIEL SATELLITE (S-51)

BY
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COMPILATION, DESIGN TESTS
ARIEL SATELLITE (S-51)

By

Francis N. LeDoux

CONTENTS

FOREWORD

A compilation of engineering design tests that were conducted in direct support of the Ariel I (S-51) satellite program by the personnel of the Structural and Mechanical Laboratory Section, Mechanical Systems Branch, Spacecraft Technology Division, Space Sciences and Satellite Applications Directorate is herein contained.

The prime purpose of conducting these engineering design tests was to insure, to the highest possible degree, the adequacy and reliability of the Ariel I engineering designs. In all cases conclusions made as a result of these tests were those of the test requestor.

Francis N. LeDoux

I - MOMENT OF INERTIA

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-8

TE	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Moment of Inertia

Date of Test: 14 & 15 June '61

Requested by: T. Eng

Performed by: Tony Pierro, Bob Dallatore

Purpose of Test: To determine moments of inertia of the components of the S-51.

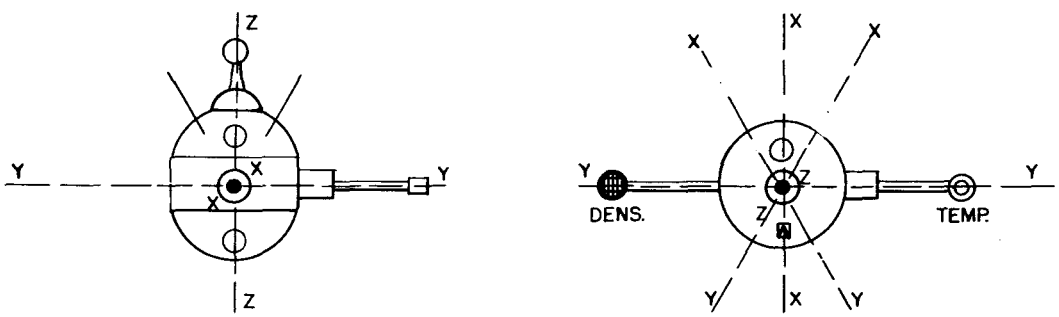
Description of Article Tested (Photographs, if any): ETU #1 structure with ETU #2 components except battery pack, cosmic ray analyzer, antennas, paddles. Booms from prototype.

Test Equipment (Photographs, if any):

22# Disc. M of I = .085 slug-ft^2
Wire .187" ⌀ x 36"
Alum. Disc. M of I = .006 slug-ft^2
2 bands + bar assembly M of I = .085 slug-ft^2

Test Procedures:

Z-Z axis = spin axis
X-X axis = horizontal thru Lyman-alpha & X-ray
Y-Y axis = horizontal thru experimental booms.



Ten oscillations repeated four times for each configuration.

Results: See page 2

Conclusions:

Test No.	Axis	Antennas	Exp. Booms	Mass Booms	Paddles	Balance Weights	Basic Structure	Payload	Moment of Inertia	
1	X-X	No	✓	No	No	No	✓	No	2.143	← Photo No. 1
2	X-Y	No	✓	No	No	No	✓	No	1.344	← Photo No. 2
3	Z-Z	No	✓	No	No	No	✓	No	2.043	← Photo No. 3
4	Z-Z	No	No	No	No	No	✓	No	0.513	
5	Z-Z	Open	No	No	Open	✓	No	✓	2.669	← Photo No. 5
6	Z-Z	Open	No	No	No	✓	No	✓	1.354	
7	X-X	Open	No	No	No	✓	No	✓	1.123	← Photo No. 7

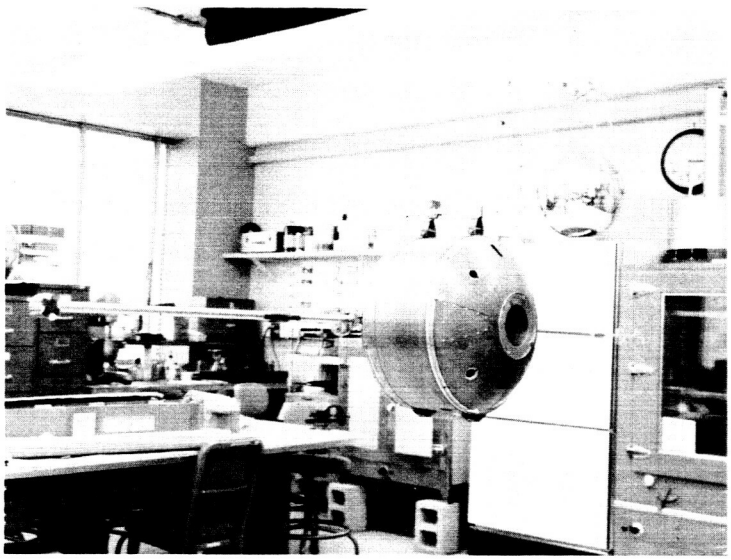


Photo No. 1–Test No. 1

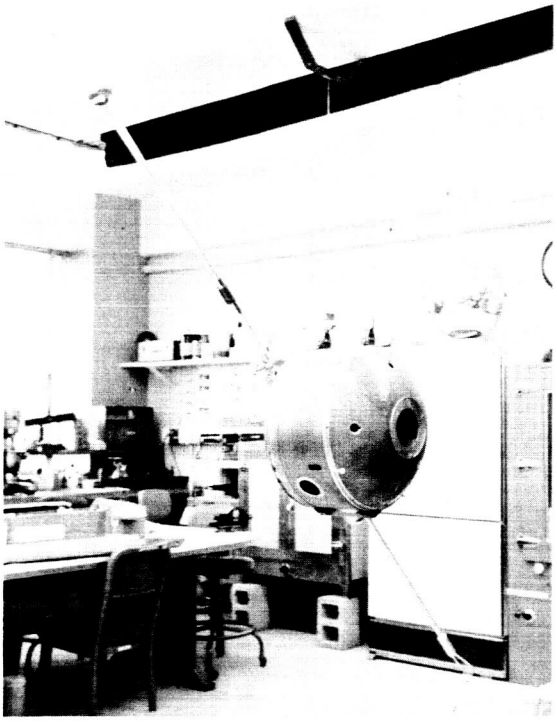


Photo No. 2–Test No. 2

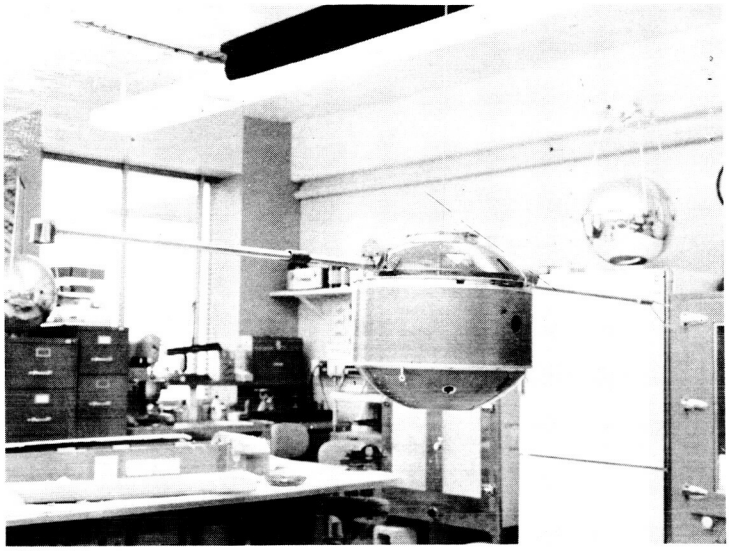


Photo No. 3–Test No. 3

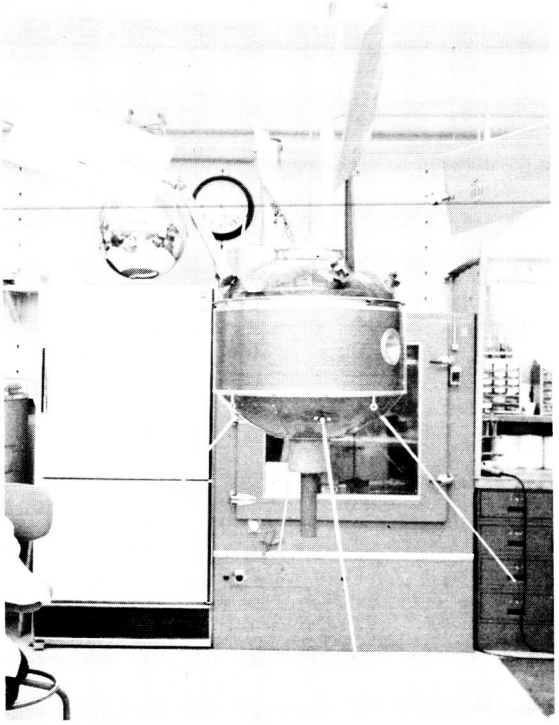


Photo No. 5–Test No. 5

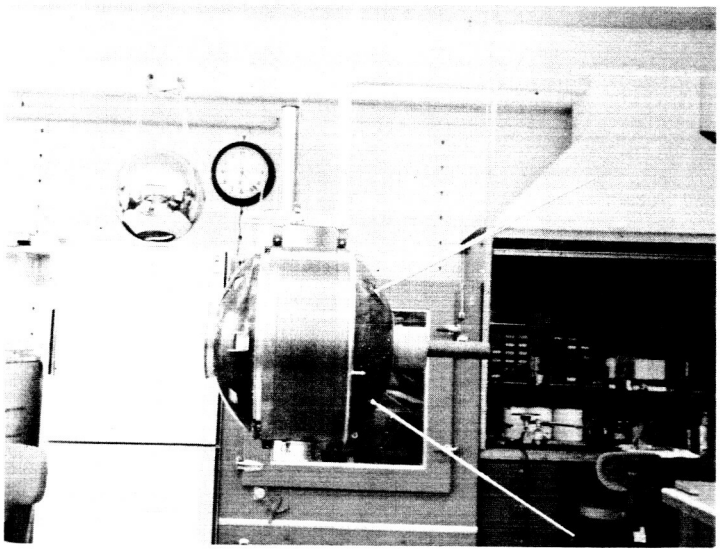


Photo No. 7–Test No. 7

File No. 500-4

CLW	P.E.
JTS	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Moment of Inertia Along Spin Axis

Date of Test: 4-22-61 & 4-23-61

Requested by: Carl Wagner

Performed by: Corbin, Pierro, Breeden, Dallatore

Purpose of Test: To determine moment of inertia for calculation purposes.

Description of Article Tested (Photographs, if any): Engineering Test Unit #1 – 116.4#.

See photo #1 – Antennas, booms, & paddles extended.

Test Equipment (Photographs, if any):

50# Disc with known moment of inertia
0.187"D steel wire, 36" long.
Stop watch

Test Procedure:

1. Fifty-pound disc was oscillated and time taken for ten oscillations. This step was repeated five times and an average time taken. This gave us an average time for one oscillation of the disc.
2. The same procedure was used with the ETU #1 in various configurations:
   A. Antennas, booms, & paddles extended.
   B. Antennas extended, booms & paddles folded.
   C. Antennas and paddles extended, booms off.
   D. Antennas extended, paddles folded, booms off.
   E. Antennas extended, paddles & booms off.
   F. Antennas extended, paddles & booms off. De-spin mechanism rotated 90°.
3. Thus we know the I_D of disc and T_D, the time for one oscillation of the disc. Finding the T_P, the time for one oscillation of the ETU #1, we can calculate I_P, the moment of inertia of ETU #1.

$$I_P = \frac{I_D \times (T_P)^2}{(T_D)^2}$$

Results:

A – 3.41 slug-ft^2	D – 1.46 slug-ft^2
B – 1.65 slug-ft^2	E – 1.22 slug-ft^2
C – 2.48 slug-ft^2	F – 1.21 slug-ft^2

Letters correspond to letters designating various configurations of ETU #1 as written in test procedure.

Conclusions:

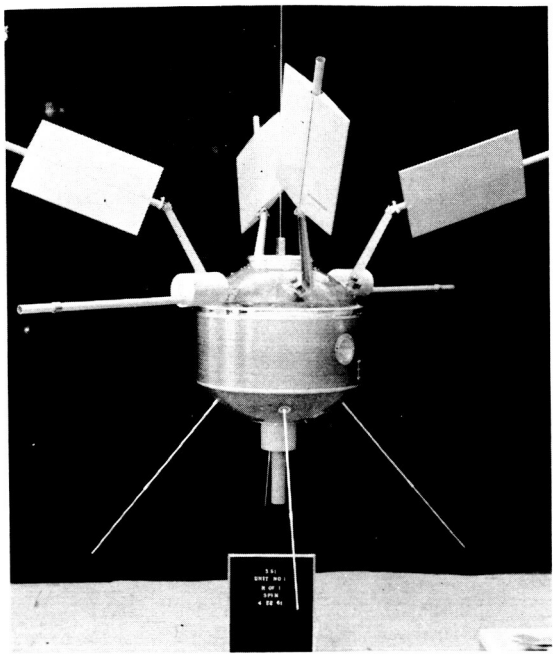


Photo No. 1—Antennas, Paddles, and Booms Extended

II – ESCAPEMENT MECHANISM

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-31

TE	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Dynamic test of escapement of unit #1 under simulated actual conditions.

Date of Test: 14 Feb '62

Requested by: Ton Eng

Performed by: J. Kauffman & T. Eng

Purpose of Test: 1. To determine time required for booms to erect with escapement attached.
2. To determine the possibility of booms erecting with escapement attached.

Description of Article Tested (Photographs, if any):

An S-51 satellite system was simulated immediately after yo-yo de-spin and prior to separation. It was mounted up-side-down on a spin table. The instrument booms were suspended with negator springs to simulate a no-"G" condition. See photo #1. Test set-up.

Test Equipment (Photographs, if any):

1. The satellite system as shown in photo #1 with modified S-3 yo-yo release mechanism for booms release.
2. Sanborn Recorder.

Test Procedure:

1. Using the latest moment of inertia values, the rotational rate of the satellite system after each sequence was calculated. The nominal spin rate for instrument boom erection was determined to be 74 rpm. To compensate for unexpected uncertainties in the system, the booms were released at 81 and 73 rpm as well as 74. This is equivalent to 74^{+10}_{-15} % rpm.
2. The negator springs were first attached to a point to give an equilibrium condition thruout a greater part of the boom travel (Location – 1) and then, secondly, negator springs were attached to a point where equilibrium is obtained when booms are at a horizontal position (Location – 2).
3. Two runs were made at the lower rpm and two runs at nominal rpm and one run at maximum rpm with negator springs attached at Location 1.
4. One run was made at 70.5 rpm with negator springs attached at Location 2.
5. Booms were locked in place each time.

Results: See Data Sheet.

Conclusions:

The results obtained in this series of test will, at best, always be controversial because it involved the simulation of a no-"G" condition. The negator spring method provides a simple, cheap, but rough simulation of the condition desired.

Negator spring attach point #1 tends to undertest, because 15° before booms reach horizontal position, the weight of the booms overcomes the springs pull and the booms erect under gravity, while negator spring attach point #2 tends to overtest because the negator springs tend to pull booms to the folded position when booms are more than 30° from horizontal.

However, this test unquestionably proved that the escapement will withstand the dynamic loads at 74^{+7}_{-11} rpm.

A force of 4 ounces is required to activate the escapement and this force has a moment arm of 3" of the escapement exerts a torque of 12 in-oz. on the boom.

If the boom hinge spring can exert a torque greater than 12 in-oz. the booms should have no difficulties in erecting under no-"G" condition.

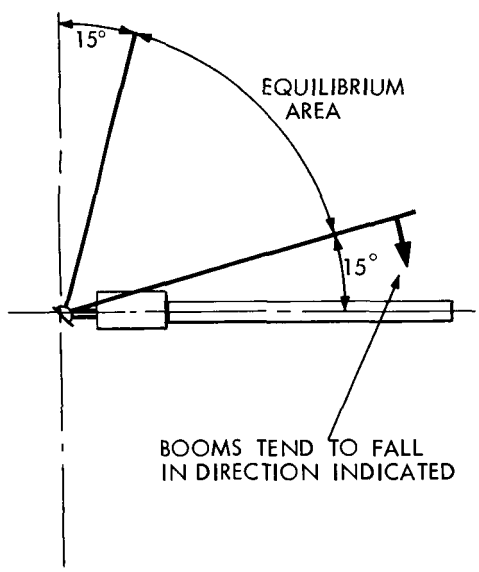
SHEET_____

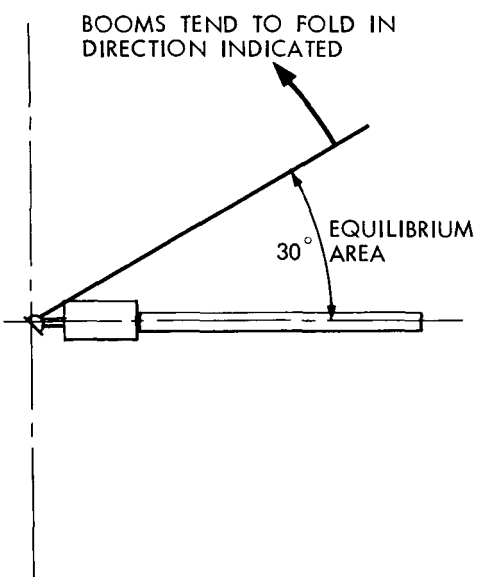
S-51 EXPERIMENTAL BOOM ERECTION TEST

NO. 1 ESCAPEMENT (NO WEIGHT ON PALLET)

Run No.	1 Rev Before Erection	Erect Time A	Erect Time B	1 Rev After Erection		
1	63	2.17	1.86	37		
2	61.1	2.21	1.93	36.2		
3	88	1.76	1.35	54.3		
4	72.1	1.97	1.53	44.1		
5	74.2	1.86	1.76	45		
6	70.5	2.20		41.7	→	NEW NEGATOR LOCATION

SPRING TENSION WHEN BOOMS ARE EXTENDED = 0.9# IN.
MINIMUM LOAD TO OVERCOME ESCAPEMENT INERTIA + FRICTION = 4.0 OZ.
FRICTION DUE TO BOOM HINGES - NOT MEASURABLE.
DECAY RATE = 1.3 REV/SEC.





NEGATOR SPRING ATTACH POINT NO. 1

NEGATOR SPRING ATTACH POINT NO. 2

DATA PAPER (11 COLUMN) PRNC-GEN-66 (REV. 9-53)

NAVY-BPPO PRNC, WASH., D.C.

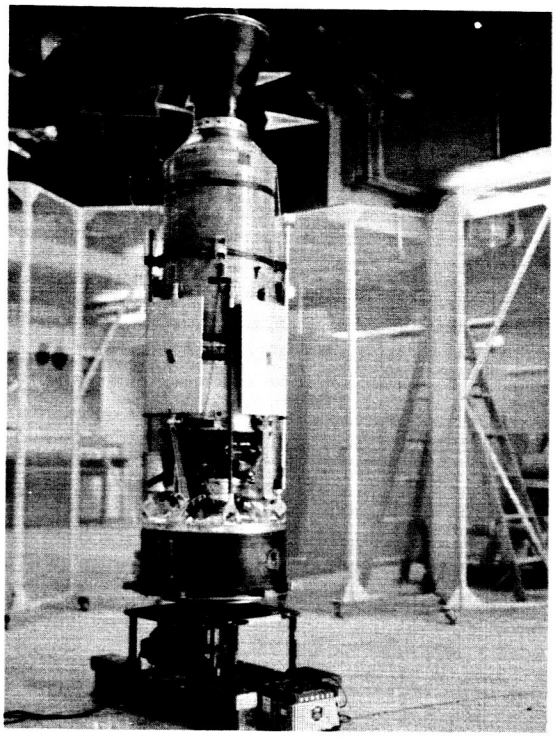


Photo No. 1—Test Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-10

TLE	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Dynamic load test of escapement (Al gears)

Date of Test: 31 July '61

Requested by: T. L. Eng

Performed by: Tony Pierro

Purpose of Test:

To determine the time with the different counterbalance weights needed to restrict the booms' momentum and the maximum capacity of the mechanism under dynamic loading.

Description of Article Tested (Photographs, if any):

Escapement gear mechanism & simulated test booms.

Test Equipment (Photographs, if any):

1. Calibrated weights
2. Two 1-1/2" pulleys
3. 90# test cord
4. Weight pans
5. Stop watch

Test Procedure:

1. Cord was secured to C.G. of boom.
2. Other end of cord was hung over pulley 36" away.
3. Weight pan was hung from cord.
4. Weight pan, fully loaded, traveled a distance of 9" causing a load on the booms thru 45° only.
5. Boom traveled the remaining 45° without additional load.
6. Distance between booms was held constant with a bar held in place with a string.
7. Time was measured from time string was cut until booms came to rest.
8. This was repeated several times with different counterbalance weights and after the proper counterbalance was selected. The same procedure was used for different loads.

Results:

Operates properly with loads ranging from 8# – 13#, but will not withstand loads of 15# or greater. See attached sheets & graphs.

Conclusions:

This test confirms the calculated results, which anticipated a maximum safe load of 10.5# but failure if the load exceeded 13#. 10-1/2# is the calculated maximum centrifugal force exerted on each boom, based on an initial satellite spin rate (after yo-yo de-spin) of 90 rpm.

The graph of Fig. 1 shows the rate of the escapement unwind with respect to a given counter weight. The first part of this curve is in error due to the fact that the data taken was from an escapement with a bent pulley shaft.

The graph of Fig. 2 shows the approximate time for a given load to travel a fixed distance (approx. 9"). This graph seems to indicate failure occurs on or slightly after an 11# load is reached.

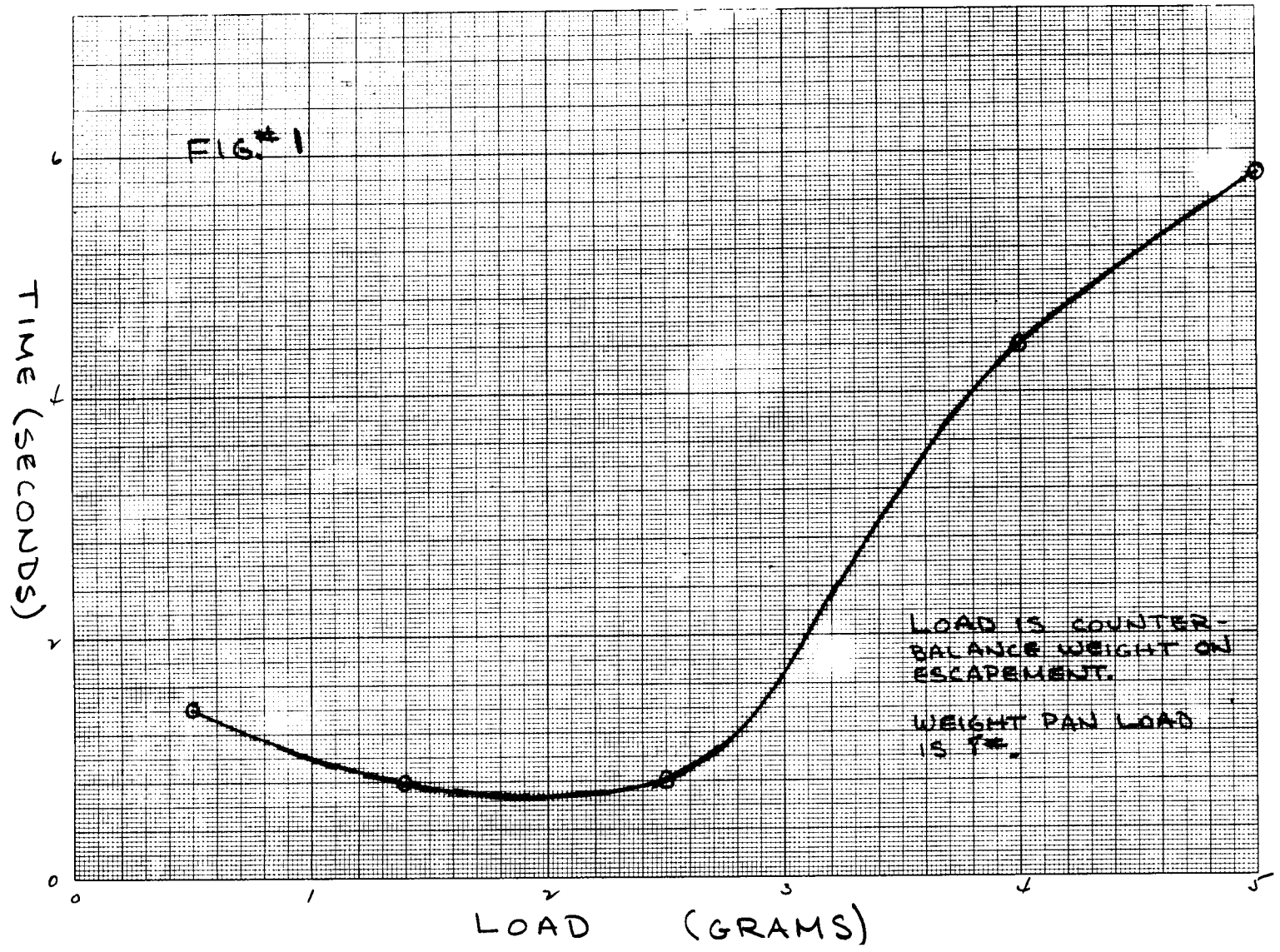


FIG. #1
TIME (SECONDS)
0
1
2
3
4
5
LOAD (GRAMS)
LOAD IS COUNTER-BALANCE WEIGHT ON ESCAPEMENT.
WEIGHT PAN LOAD IS T.

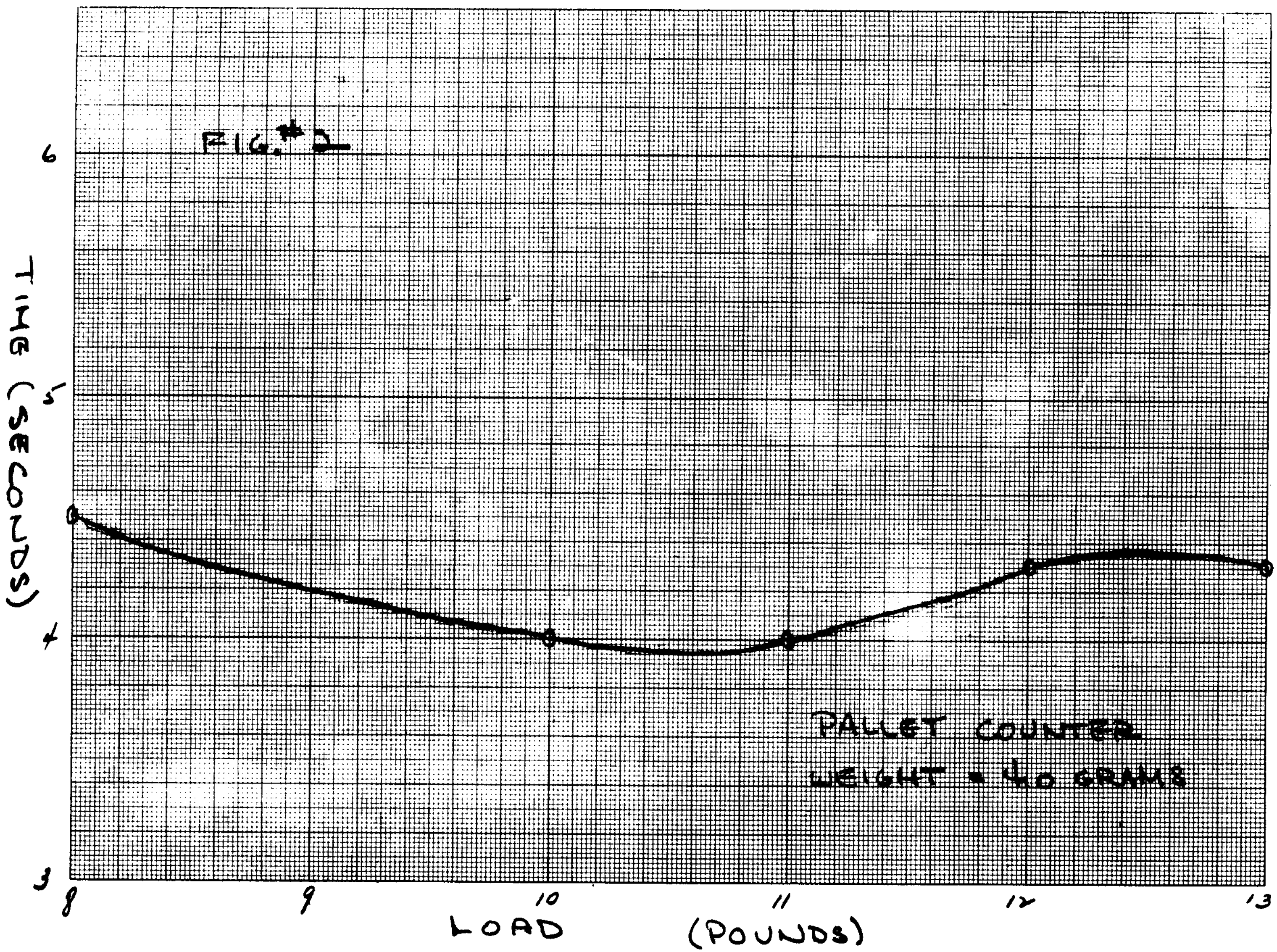


FIG. #2
PALLET COUNTER
WEIGHT = 40 GRAMS
TIME (SECONDS)
LOAD (POUNDS)
3
4
5
6
8
9
10
11
12
13

SHEET_____

S-51 ESCAPEMENT LOAD TEST

Wgts	Dist. Trav.	Time	Coun. Bal.	Wgt of Booms	C.G. of Booms					
#	in.	sec.	grams	#	in.					
8	9	1.4	0.5	5.25	9-9/32					
8	9	0.8	1.4	5.25	9-9/32					
8	9	0.8	2.5	5.25	9-9/32					
8	9	4.4	4.0	5.25	9-9/32					
8	9	5.8	5.0	5.25	9-9/32					
8	9	4.5	4.0	5.25	9-9/32					
10	9	4.0	4.0	5.25	9-9/32					
11	9	4.0	4.0	5.25	9-9/32					
12	9	4.3	4.0	5.25	9-9/32					
13	9	4.3	4.0	5.25	9-9/32					
15	TEETH IN GEAR CHEWED OFF									

Photo No. 1–Test Set-Up

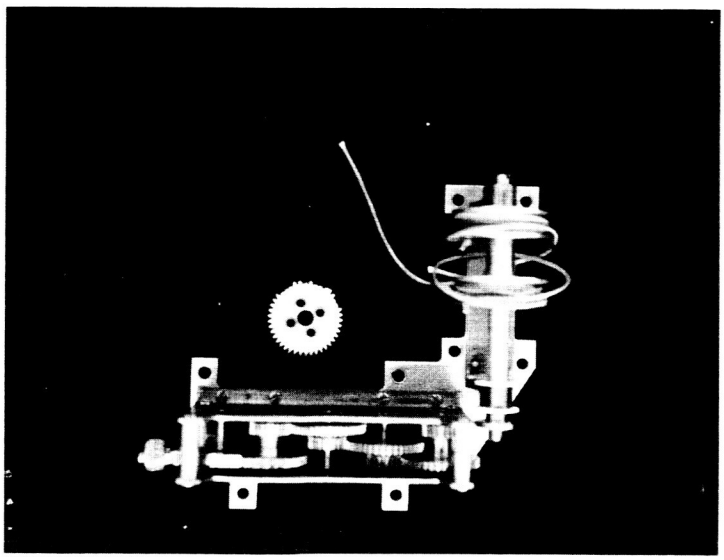


Photo No. 2–Escapement Mechanism

File No. 500-2

TE	P.E.
JTS	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Escapement unwind (T. L. Eng design) (rate & load study)

Date of Test: 21 Feb '61

Requested by: T. L. Eng

Performed by: J. H. Kauffman

Purpose of Test: To determine unwind rate

Description of Article Tested (Photographs, if any):

S-51 escapement mechanism
Ratio = 20 $\cong$ 1

Test Equipment (Photographs, if any):

1. F&M weights
2. Weight pan
3. Stop watch
4. 48" steel scale
5. 72# test line

See photo #1

Test Procedure:

1. Clamp escapement in vertical position and use outside pulley.
2. Apply load from 1# – 12# in 1# increments.
3. Load escapement & record time for 10" payout. Repeat 3 times.
4. Plot time vs. load.
5. Make runs of original configuration.
6. Make runs with 0.4 grams added to pallet wheel.
7. Load with 1,3,5 & 7 pounds.

Results:

Escapement gears did not shear during test. See graph & data sheet.

Conclusions:

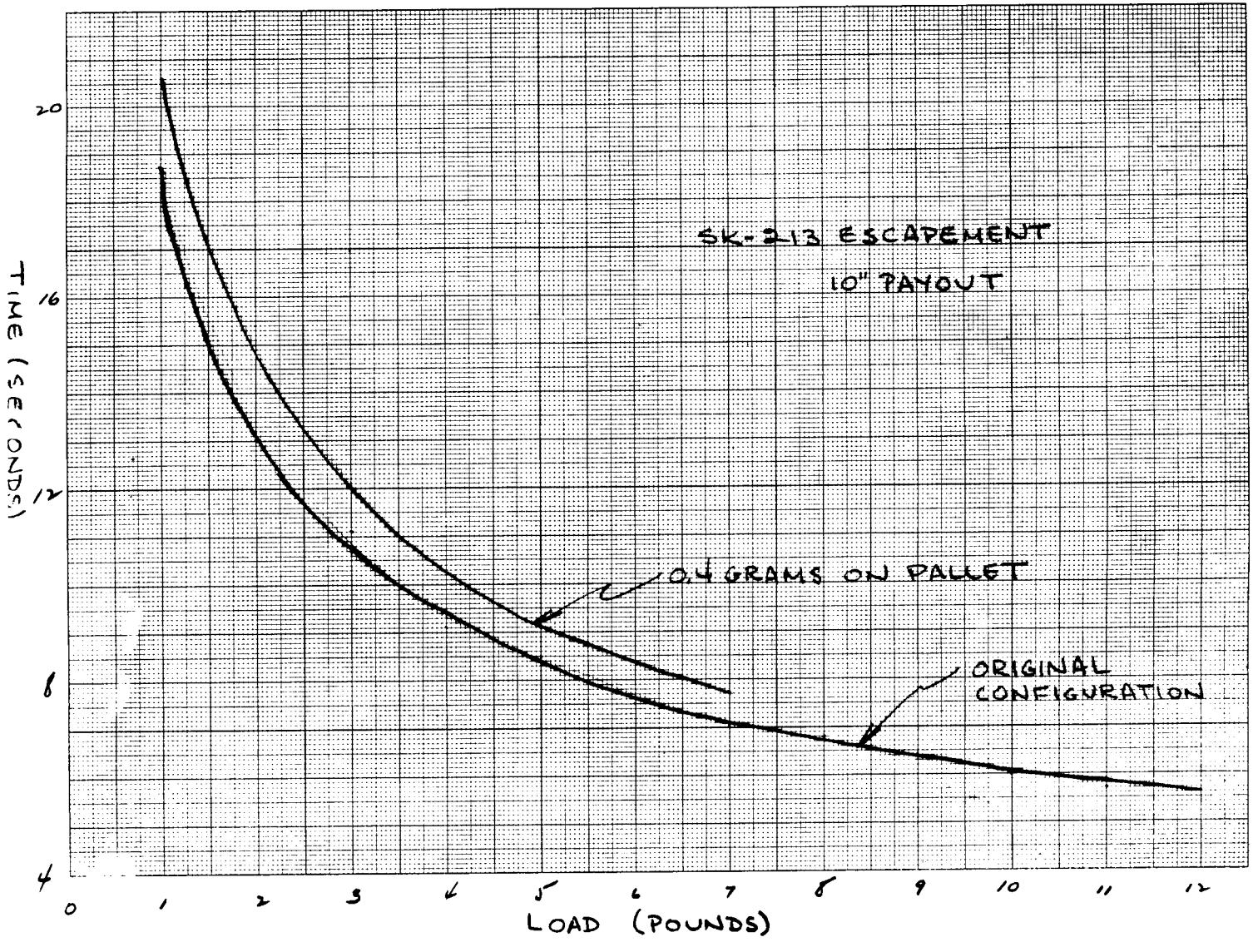
After the completion of this test, a careful inspection was made of all components. No evidence of wear was found. Therefore it is safe to conclude that the design is structurally sound.

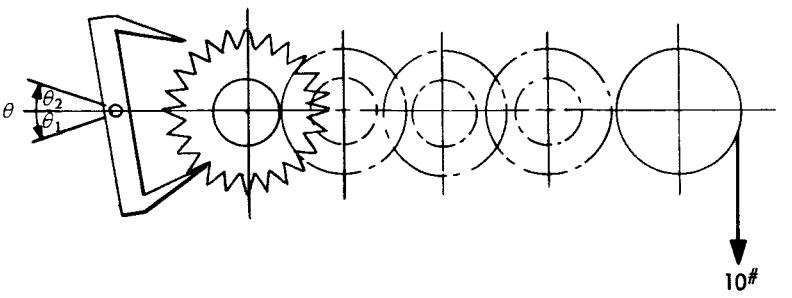
From the calculations shown on the following page the time required for unwind of 10" is 4.72 seconds and the actual time is 6 sec. There are several factors which might account for this error.

1. Moment of inertia for y_2 of pallet is not accurate.
2. θ_1 may not be sufficiently accurate.
3. Equation used did not consider effects of friction & inertia of system.
4. Human error in timing.

However, the 21% error will not affect the employment of this mechanism. The tenative time required for boom erection is 3 sec. and the anticipated length of actual unwind is approx. 6". This condition indicates that adjustment of mechanism may not be necessary.

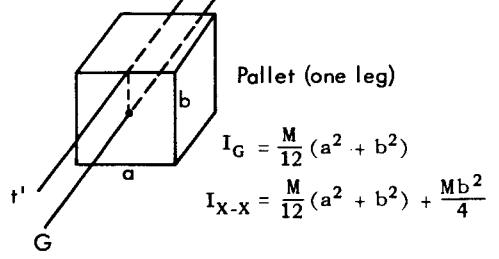
J. H. Kauffman
T.L. Eng


SK-2-13 ESCAPEMENT
10" PAYOUT
0.4 GRAMS ON PALLET
ORIGINAL CONFIGURATION
TIME (SECONDS)
LOAD (POUNDS)
20
16
12
8
4
0
1
2
3
4
5
6
7
8
9
10
11
12



ESCAPEMENT-RATE OF UNWIND CALCULATIONS

$t_1 = \sqrt{\frac{2I_{P_1}\theta_1}{T_{P_1}}}$ [From PRODUCT ENGINEERING Jan 57]



$I_G = \frac{M}{12}(a^2 + b^2)$

$I_{X\text{-}X} = \frac{M}{12}(a^2 + b^2) + \frac{Mb^2}{4}$

t_{10} = Time for 10 in. unwind

$\theta = \theta_1 + \theta_2$ = L of osc. of pallet

I_{P_1} = Moment of Inertia of 1/2 of pallet

t_1 = Time required for pallet to travel θ_1

T_{P_1} = Torque on pallet

N = # of revolutions of pulley for 10 in. unwind

N_T = # of teeth on scape wheel which pass thru pallet

Assumed: One leg of pallet takes shape above

Then: $I_{P_1} = 3.42 \times 10^{-5}$ #-in.^{2}

$\theta_1 = 6°$ by measuring layout

$T_{P_1} = 0.012$ in.-# (using 10# load shown)

$t_1 = 0.001245$ sec.

Assume $\theta_1 = \theta_2$

Then: $t_1 = t_2$

$\therefore t\theta = 2 \times .001245 = .00249$ sec

Gear Ratio = 22.77:1 Pulley Diameter = 0.875 $N = \frac{10}{.875\pi} = 3.64$ revolutions

$N_W = 21.77 \times 3.64 = 79$ revolutions

$N_T = 79 \times 24 = 1896$

$t_{10} = t\theta \times N_T = .00249 \times 1896 = 4.72$

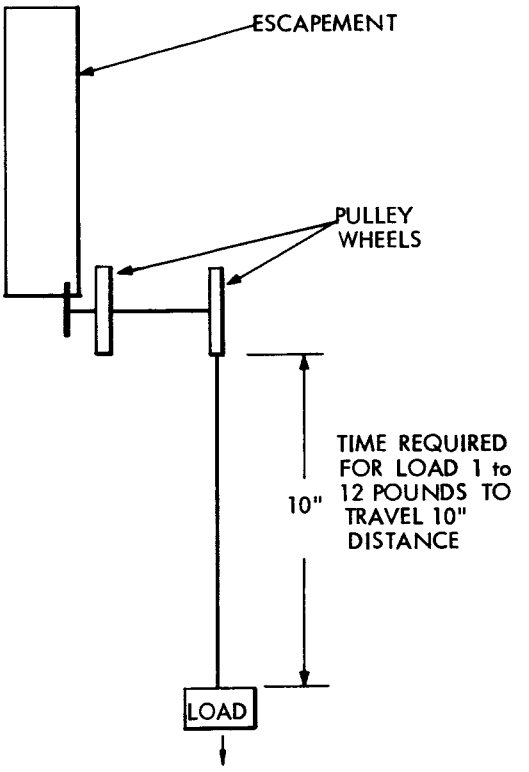
ERROR $= \frac{6 - 4.72}{6} \times 100 = 21.3\%$

SHEET_____

S-51 ESCAPEMENT

10" Payout

Load	Run No. 1	Run No. 2	Run No. 3	Avg.	
pounds	sec	sec	sec	sec	
1	18.9	18.7	18.6	18.7	
2	12.9	13.0	13.0	13.0	
3	10.4	10.7	11.0	10.7	
4	9.2	9.0	9.3	9.1	
5	8.4	8.5	8.6	8.5	
6	7.6	7.4	7.6	7.5	ORIGINAL
7	7.0	6.9	7.0	7.0	CONFIGURATION
8	6.8	6.8	6.8	6.8	
9	6.4	6.4	6.5	6.4	
10	6.0	6.1	6.0	6.0	
11	5.7	5.6	5.8	5.7	
12	5.5	5.7	5.6	5.6	
1	20.8	20.5	20.4	20.6	
3	11.9	12.0	12.0	12.0	0.4 GRAMS
5	9.1	9.0	9.1	9.1	ON PALLET
7	7.7	7.6	7.8	7.7	


ESCAPEMENT
PULLEY WHEELS
TIME REQUIRED FOR LOAD 1 to 12 POUNDS TO TRAVEL 10" DISTANCE
10"
LOAD

Not to Scale

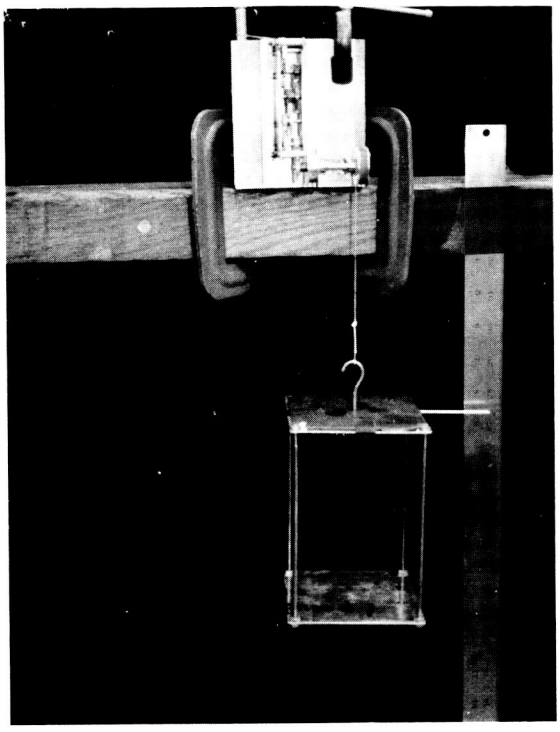


Photo No. 1—Test Set-Up

File No. 500-3

TE	P.E.
JTS	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Escapement unwind

Date of Test: 2 March '61

Requested by: Ton Eng

Performed by: John Sween

Purpose of Test: Mechanical breakdown of escapement unwind.

Description of Article Tested (Photographs, if any):

See SK-213 test report file #500-2

Test Equipment (Photographs, if any):

1. F&M weights
2. Weight pan
3. Stop watch
4. 36" steel scale
5. 72# test line dacron
6. Stainless steel wire

Test Procedure:

1. Clamp escapement in vertical position and use outside pulley.
2. Apply load from 10# – 53# in 2# increments.
3. Load escapement and record time for 10" payout.
4. Dacron line was used from 10# – 41#.
5. Stainless steel wire from 43# – 51#.
6. Each load was repeated 3 times..

Results:

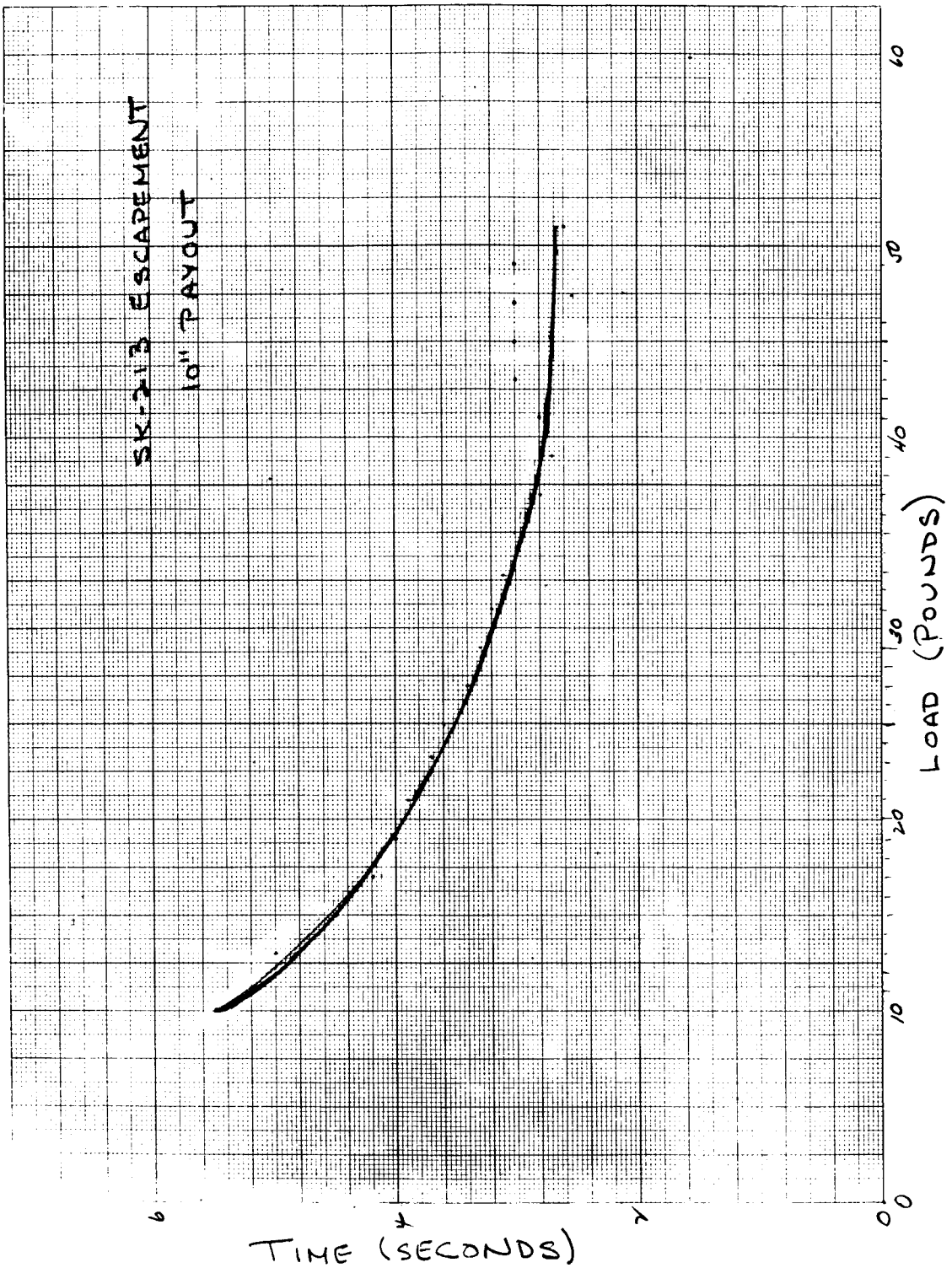
See graph & data sheet. With a load of 51#, the pulley slipped on the shaft. Set screw on pulley was retightened.

Slight binding in mechanism was then discovered and test was stopped.

Conclusions:

The binding mentioned above was due to the failure of the pulley shaft bearing. The escapement itself shows no evidence of failure.

In examining the stainless steel wire it was found to be relatively stiff. It is doubtful that wire would unwind as smoothly as string. Rough unwind created an intermittent shock loading condition on the pulley bearing. This loading condition probably caused pulley bearing to fail prematurely. However, this test shows that escapement can withstand 400% of max calculated load. Pulley slippage was due to manufacturing error. The pulley should have been doweled to the shaft with a screw dowel as called for in the drawing, rather than by set-screw.


SK-213 ESCAPEMENT
10" PAYOUT
LOAD (POUNDS)
0
10
20
30
40
TIME (SECONDS)
0
4
7
9

SHEET _____

S-51 ESCAPEMENT

10" Payout

Load	Run No. 1	Run No. 2	Run No. 3	Avg.	
pounds	sec.	sec.	sec.	sec.	
10	5.4	5.4	5.6	5.5	
11	5.2	5.2	5.2	5.2	
13	4.8	5.0	5.0	5.0	
15	4.6	4.4	4.4	4.5	
17	4.2	4.2	4.2	4.2	
19	4.0	4.0	4.0	4.0	
21	4.0	3.8	3.8	3.9	
23	3.8	3.6	3.6	3.7	
25	3.6	3.4	3.6	3.6	
27	3.4	3.4	3.4	3.4	
29	3.4	3.2	3.2	3.3	
31	3.2	3.0	3.2	3.2	
33	3.2	3.0	3.0	3.1	← STRING BROKE
35	3.0	3.0	2.8	3.0	
37	2.8	2.8	2.8	2.8	
39	2.6	2.8	2.6	2.7	
41	2.8			2.8	← USING STAINLESS STEEL
43	3.0			3.0	WIRE
45	3.0			3.0	
47	3.0			3.0	
49	3.0			3.0	
51	2.6			2.6	
53					← PULLEY SLIPPING

III - EXPERIMENTAL AND MASS BOOMS
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-22

RF	P.E.
JTS	S.H.
RCB	B.H.

Name of Test: Experimental Boom Erection (atmos.)

Date of Test: 22-29 Nov. '61

Requested by: Dick Forsythe

Performed by: J. H. Kauffman, Sween, Pierro, Forsythe, Eng, Treadwell.
T & E (Lang & Harback).

Purpose of Test: To find time necessary for booms to erect.

A. At various rpm's
B. Escapement pallet weights
C. Different escapements
D. Different escapement string attachment locations
E. Bungee cord location

Description of Article Tested (Photographs, if any):

S-51 payload & appendages, with separation, dutchman, dummy X-248 rocket motor.
Unit #1 & #2 escapements with 90# dacron string.
Experimental booms. (Dummy-same C.G. & weight as flight hardware).

Test Equipment (Photographs, if any): Same as test #500-20

1. Spin table (freespin) approx. decay rate = 1/2-rpm/sec.
2. Two channel Sandborn recorder.
3. Microswitches.
4. Rpm indicator (360° pot).
5. Modified S-3 yo-yo release mechanism.

Test Procedure:

1. Mount S-51, separation, X-248 rocket motor to spin table.
2. Slug 1 to get M. of I. of 2.885 slug-ft^2.
3. Mount microswitches for erection time.
4. T & E personnel mount bungee cord to simulate no-"G" condition. Ok'd by MSB engineer.
5. Hook-up necessary wiring, microswitches, & rpm indication to Sandborn recorder & calibrate.
6. Hook-up release mechanism.
7. Run decay-rate. Spin up to 90 rpm & decay to 0 rpm. All appendages in folded condition. Decay rate = 1/2-rpm/sec.
8. Run tests as per MSB engineer's instructions.

Results:

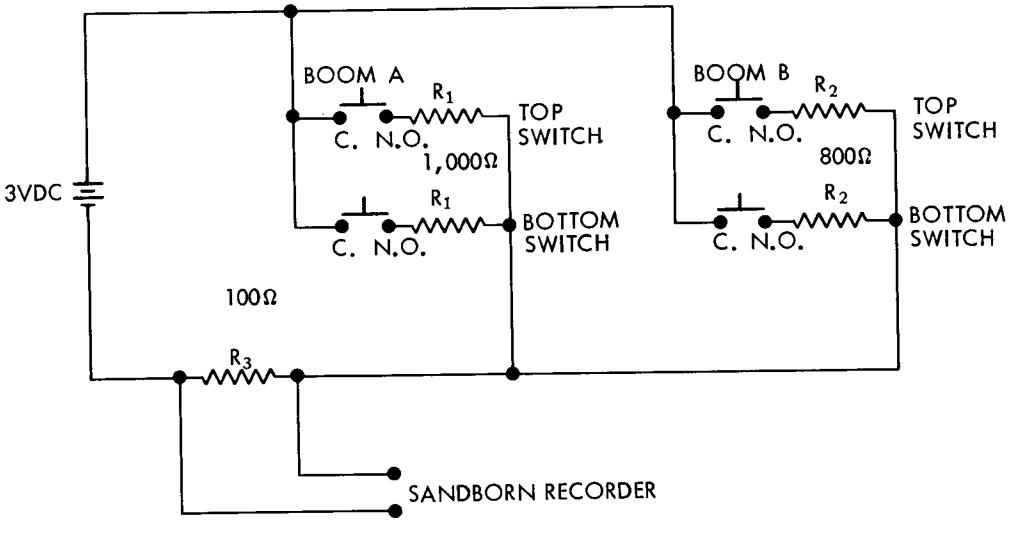
See attached sheets. See code 634.3 for Sandborn records.

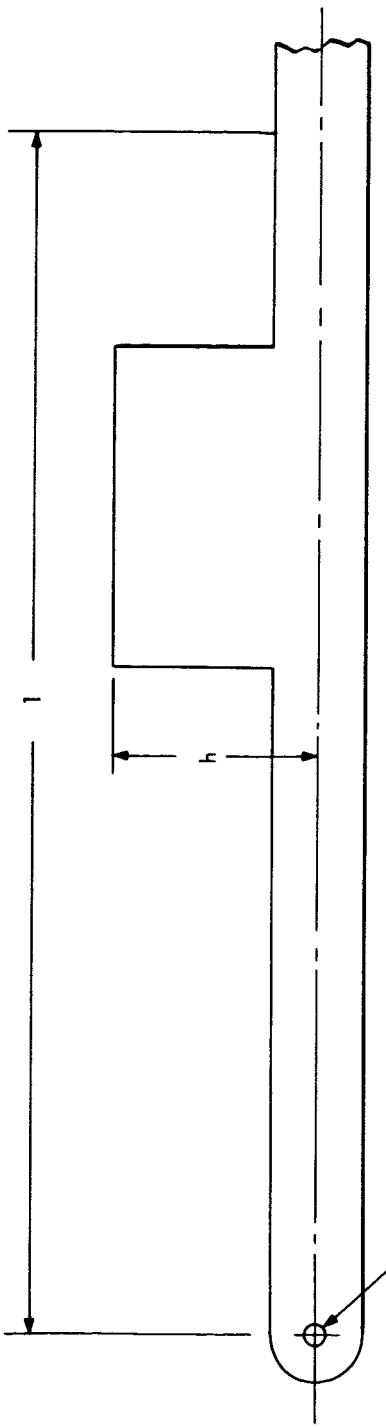
Conclusions:

SK-2

S-51

Micro -Switch Circuit





l = Length of Bungee Attachment (other end of Bungee attached to X-248 motor)
h = Height of Escapement String Location (C.L. of Hinge Pin = 0" & Top = Original)

S-51 EXPERIMENTAL BOOM ERECTION TEST

Run No.	RPM 1 Rev. Before Erection	Erection Time in Seconds	Escapement No. / Wt. on Pallet	Bungee* Cord Length	Escapement* String Attachment	Remarks
1	68	-	1 / 3 gms.	14.2"	Original	BOOMS DID NOT ERECT
2	82	-	1 / 3 gms.	↓	↓	BOOMS DID NOT ERECT
3	81	-	1 / 3 gms.	13"	↓	BOOMS ERECTED - MICRO-SWITCHES DID NOT INDICATE - READJUSTED
4	65	2.64	1 / ?	↓	↓	BOOMS ERECTED - ESCAPEMENT PALLET
5	82	1.81	↓	↓	↓	WEIGHT MAY HAVE BROKEN OFF DURING
6	73	1.97	↓	↓	↓	RUN No. 4, CONTINUE TEST WITHOUT
7	63	2.32	↓	↓	↓	REPAIR
8	65	2.24	↓	↓	↓	ESCAPEMENT PALLET WEIGHT WAS FOUND OFF AT THE END OF RUN NO. 8
9	70	6.93	1 / 2 gms.	↓	↓	BOOMS ERECTED
10	62	-	1 / 2 gms.	↓	↓	BOOMS DID NOT ERECT
11	63	4.0	1 / 1 gm.	↓	↓	BOOMS ERECTED
12	81	3.5	1 / 1 gm.	↓	↓	BOOMS ERECTED
13	58	5.0	2 / 1 gm.	↓	↓	BOOM A ERECTED BOOM B ONLY (1) DETENT LOCKED --
14-R	63	4.12	2 / 1 gm.	↓	↓	BOOM A ERECTED BOOM B ONLY (1) DETENT LOCKED.
15	67	3.12	2 / 0.8 gm.	↓	↓	BOOM A ERECTED BOOM B DETENTS 1/2 WAY IN LOCK POSITION
16	63	2.68	2 / 0.8 gm.	10.2"	↓	↓
17	83	2.52	2 / 0.8 gm.	↓	↓	↓
18	63	0.5	2 / 0.8 gm.	↓	0.8"	BOOMS ERECTED - MUCH DEFLECTION NOTICED WHEN BOOMS LOCKED-IN
19	65	2.4	2 / 0.8 gm.	↓	3.1"	BOOM A ERECTED BOOM B DETENTS 1/2 WAY IN LOCK POSITION
20	64	2.23	2 / 0.8 gm.	↓	2.0"	BOOM A ERECTED BOOM B DETENTS 1/2 WAY IN LOCK POSITION
NOTE: RUN NO. 16 THRU RUN NO. 20 ESCAPEMENT PALLET WEIGHT MAY HAVE BEEN OFF – THE WEIGHT WAS OFF AT THE END OF RUN NO. 20.						
21	63	1.32	2 / 0.2 gm.	10.2"	1.75"	BOOM A ERECTED – STRING BROKE BOOM B DETENTS NOT LOCKED
22	63	0.8	2 / 0.2 gm.	10.2"	1.5"	BOTH BOOMS ERECTED – MUCH DEFLECTION NOTICED
23	65	0.7	2 / 0.2 gm.	↓	↓	↓
24	82	0.4	2 / 0.2 gm.	↓	↓	↓
25	84	0.36	2 / 0.2 gm.	↓	↓	↓

DATA PAPER (11 COLUMN) PRNC-GEN-66 (Rev. 9-53) NAVY-BPPO PRNC, WASH., D.C.

*See Sketch

S-51 EXPERIMENTAL BOOM ERECTION TEST

Run No.	RPM 1 Rev. Before Erection	Erection Time in Seconds	Escapement No. / Wt. on Pall	Bungee* Cord Length	Escapement* String Attachment			Remarks		
26	63	2.35	2 / 0.2 gm.	10.2"	Original	BOOM A ERECTED				
				↓	↓	BOOM B DETENTS 1/2 WAY IN LOCK POSITION				
27	80		2 / 0.2 gm.	↓	↓	ESCAPEMENT JAMMED				
REMOVE BUNGEE CORD NO - "G" SIMULATOR & INSTALL NEW NO- "G" SIMULATOR (NAGATOR-MOTOR)										
28	62	2.64	1 / 0.2	11.2"	1.62"	BOOM A DETENTS DID NOT LOCK				
						BOOM B ERECTED				
29	63	2.55	1 / 0.2	11.2"	1.75"	BOOM A DETENTS DID NOT LOCK				
						BOOM B ERECTED				
30	80	0.5	1 / 0.3	11.2"	1.75"	BOTH BOOM ERECTED MUCH DEFLECTION NOTICED WHEN				
						BOOMS ERECTED				

DATA PAPER (11 COLUMN) PRNC-GEN-66 (Rev. 9-53)

NAVY-BPPO PRNC, WASH., D.C.

*See Sketch

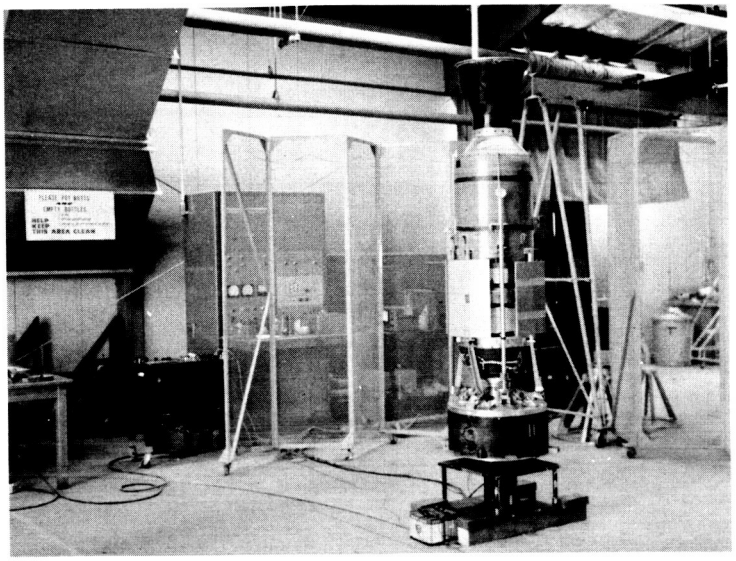


Photo No. 1—Test Set-Up

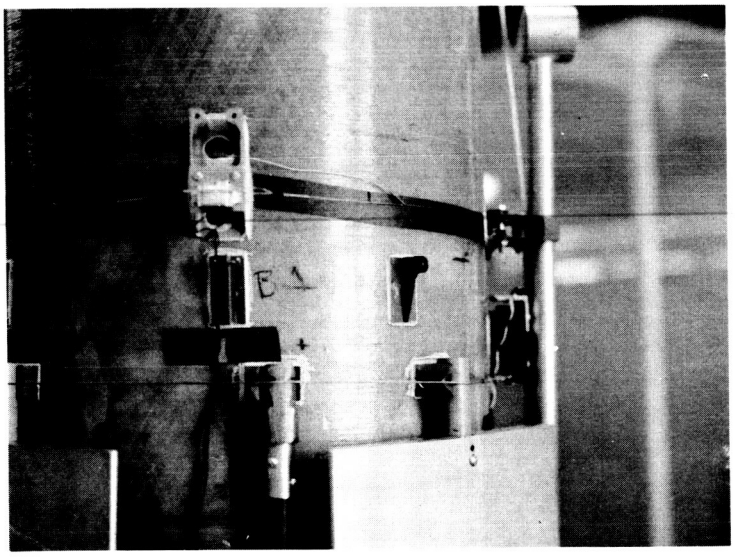


Photo No. 2–Release Mechanism

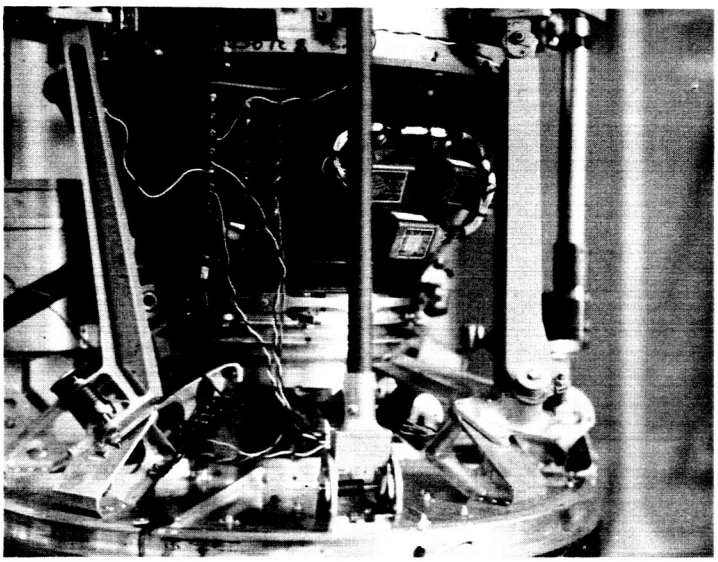


Photo No. 3–Micro-Switch Resistor Board

File No. 500-20

RWF	P.E.
CLW	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH

SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Cornfield Appendage Erection Test

Date of Test: 4 Oct 1961

Requested by: R. Forsythe

Performed by: Forsythe, King, Kauffman, Paul

Purpose of Test: To test appendage structures and method of simulating no-"G" during erection by overspinning.

Description of Article Tested (Photographs, if any):

The S-51 payload was weighted till it and the mounting fixture it sat on had a total spin inertia of 27,329 lb-in^2 (all appendages extended) measured. The actual inertia of payload & 3rd stage is 27,405 lb-in^2.

Test Equipment (Photographs, if any):

1. Spintable rigged to disengage drive motor on command allowing freespinning of the payload.
2. Sanborn Recorder.
3. Back stands to measure deflection.
4. High speed cameras–1000 frames/sec.
5. Microswitches.

Test Procedure:

1. Start countdown at T+ 10 sec.
2. Start camera at T+4 sec.
3. Start recorder at T+2 sec.
4. Disengage clutch at T+ 1 sec.
5. Fire dimple motors releasing appendages at T+0 sec.
6. Record for 5-10 sec.

Results: See Data Summary Sheet.

Run #1. Mass booms withstood test.
#2. Mass boom & paddles erected. Detent pins on secondary hinges of paddles #2 & #4 sheared off.
#2R. Mass booms o.k. Secondary hinges on paddles #2 & #4 broke.
#3. Experimental booms erected to about 80°.
#4. Experimental booms erected. One escapement line broke and the detent pin sheared. The other boom erected to about 80°.
#5. Mass booms withstood test.
#6. Paddles withstood test.
#7. Paddles withstood test.

Conclusions:

1. The secondary hinge on paddle arms #2 & #4 needs to be strengthened and detent pins redesigned.
2. More investigation into the erection of the experimental booms should be done to insure complete erection. (See summary sheet).
3. The simulations of no-"G" loading (at erection position only) seems to be proven correct.

DATA SUMMARY SHEET

Run No.	Run No.
1 - MASS BOOMS	4 - EXPERIMENTAL BOOMS
2 - MASS BOOMS & PADDLES	5 - MASS BOOMS
2R - MASS BOOMS & PADDLES	6 - PADDLES
3 - EXPERIMENTAL BOOMS	7 - PADDLES

	No. 1	No. 2	No. 2R	No. 3	No. 4	No. 5	No. 6	No. 7	Units
Instrument Travel	3.980	3.965	3.960	3.970	3.965	3.980	3.970	3.960	in./sec
Resistor Pot Travel Before Erection	3.590	3.540	3.565	3.010	2.625	2.845	3.960	2.945	in./Rev
RPM Before Erection	66.48	67.2	66.64	79.2	90.7	83.88	60.2	80.7	RPM
Mass Boom Erection Time	.422 1.68	.487 1.930	.499 1.975			.343 1.365			sec
Paddle Erection Time		 1.060 .257	1.020 1.110 .258 .280				1.090 1.170 .275 .295	.45 .83 .114 .209	
Experimental Booms Erection Time			NO ERECTION						sec
Mass Boom Oscillations	21	16	15			21			#
Resistor Pot Travel After Erection	4.480	5.530	5.510	3.725	3.520	3.605	5.240	3.870	in./Rev
Instrument Travel	3.985	3.960	3.980			3.980	3.970	3.965	in./sec.
RPM After Erection	53.37	42.96	43.01	63.9	67.2	66.24	45.5	61.6	RPM
Boom Deflection	6.0		6.0			8.0			in.

File No. 500-15

RWF	P.E.
JTS	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Boom Deflection Data Test

Date of Test: 7 & 8 Sept. '61

Requested by: R. Forsythe

Performed by: Kauffman, Sween, Flately

Purpose of Test: To find failure point of boom.

Description of Article Tested (Photographs, if any):

13.75" stock fiberglass tubing (synthane)
O.D. = .761"
I.D. = .365"

Test Equipment (Photographs, if any):

1" travel dial indicator
Webber gage blocks
Weight pans
Weights "F&M"
Clamps
1/2" bolt & washer
Cable
Aluminum block

Test Procedure:

1. Tubing was inserted in aluminum block with .763 bore & block was clamped to surface plate.
2. End of tube was tapped for 1/2" bolt with washer to hold the cable on the tube, See SK-1.
3. Weights were added in 5# increments & deflection readings were taken for each increment.
4. No load readings were taken at each increment.
5. Load was applied until failure.

NOTE: Webber gage blocks were used when deflection was more than one inch.
See SK-2.
See Photos #1 & #2.

Results:

Graph
Data Sheet

Conclusions:

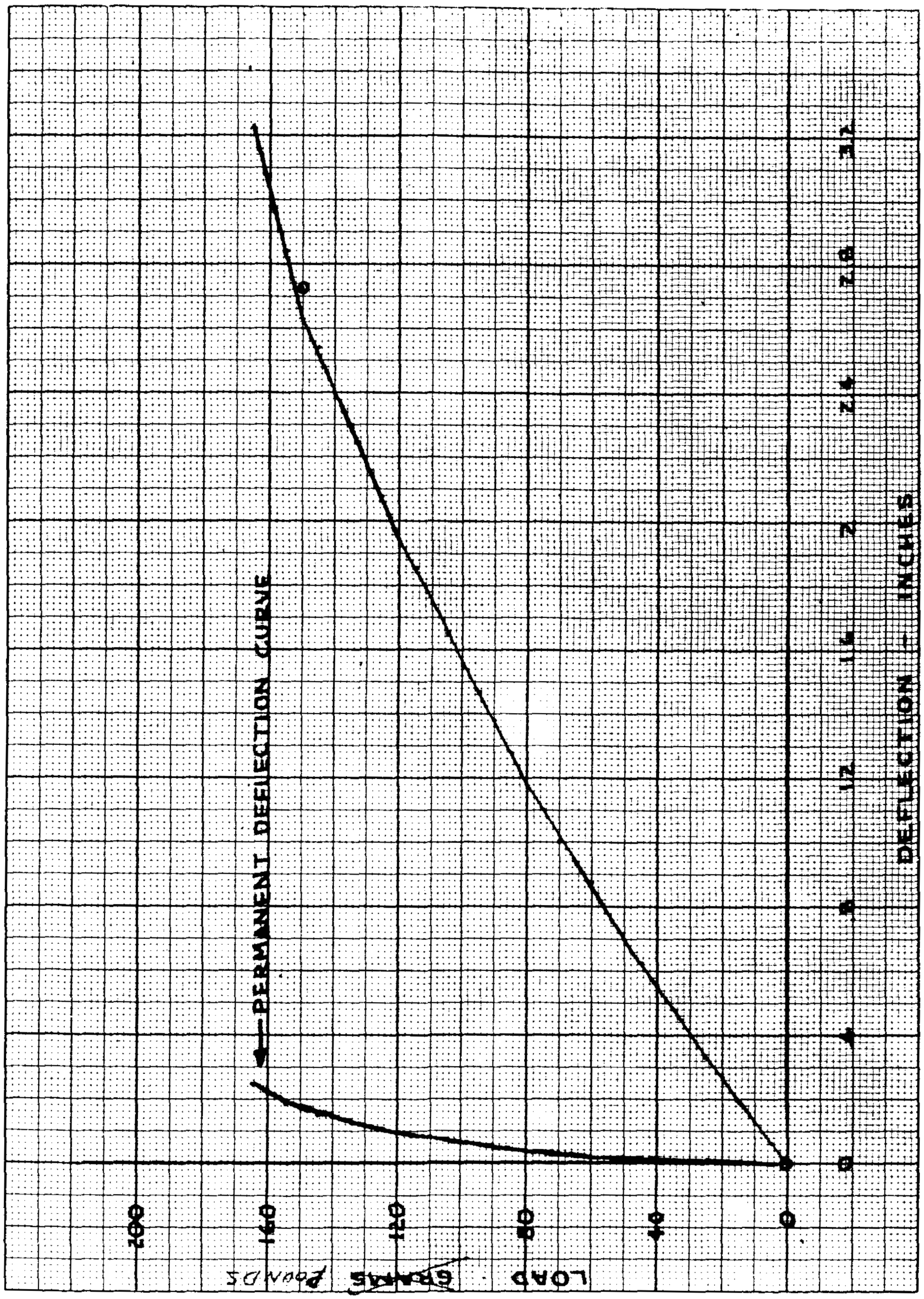
SHEET_____

BOOM DEFLECTION DATA SHEET

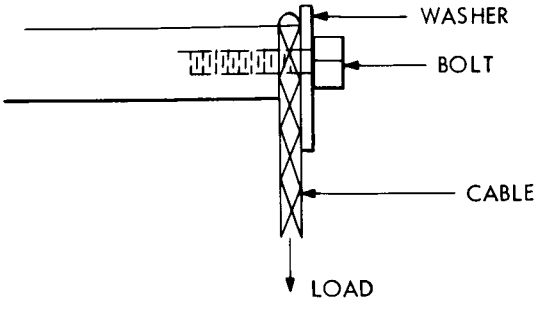
# Load	In. Defl.	In. # Load	READING AFTER SHOWN LOAD WAS REMOVED
0	0	0	
5	0.063	0.0005	
10	0.129	0.0015	
15	0.194	0.0025	
20	0.265	0.003	
25	0.330	0.005	
30	0.400	0.007	
35	0.481	0.009	
40	0.553	0.011	
45	0.626	0.013	
50	0.700	0.015	
55	?	?	
60	0.875	0.018	← TUBE CREEPED AS READING WAS TAKEN
65	0.929	0.021	
70	1.013	0.028	
75	1.112	0.035	
80	1.189	0.042	
85	1.280	0.048	
90	1.385	0.054	
95	1.465	0.059	
100	1.555	0.067	
105	1.650	0.072	
110	1.745	0.080	
115	1.852	0.090	
120	1.945	0.095	
125	2.074	0.112	
130	2.170	0.116	
135	2.300	0.130	
140	2.400	0.145	
145	2.540	0.155	← FIBERS BEGINNING TO SEPARATE
150	2.630	0.180	- LOWER SIDE OF TUBE
155	2.840	0.190	
160	3.020	0.230	
165	3.230	0.250	
170	FAIL	FAIL	

DATA PAPER (11 COLUMN) PRNC-GEN-66 (Rev. 9-53)

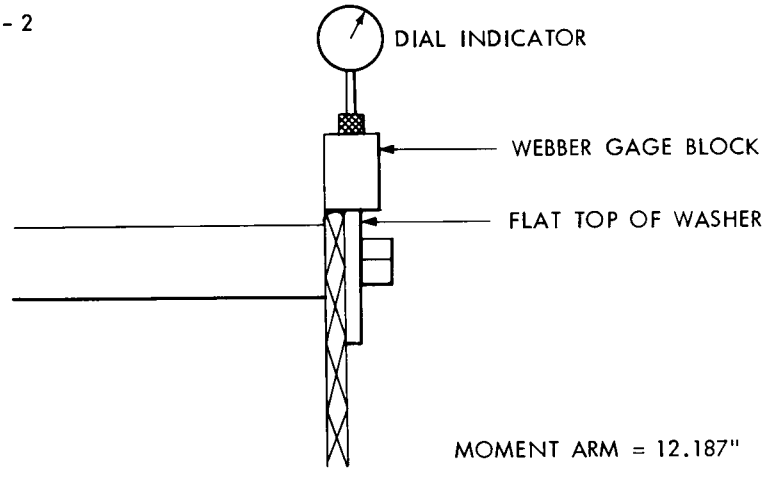
NAVY-BPPO PRNC, WASH., D.C.


PERMANENT DEFLECTION CURVE
DEFLECTION – INCHES
LOAD GRAMS POUNDS
0
40
80
120
160
200

SK - 1


WASHER
BOLT
CABLE
LOAD

SK - 2


DIAL INDICATOR
WEBBER GAGE BLOCK
FLAT TOP OF WASHER
MOMENT ARM = 12.187"

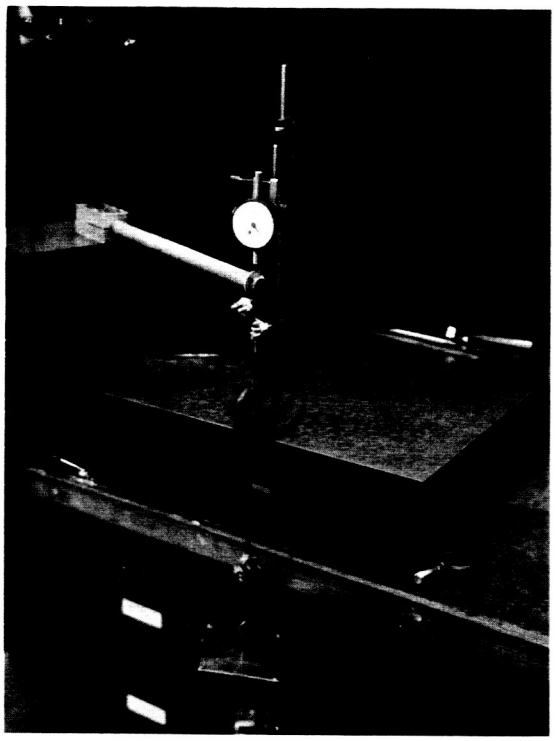


Photo No. 1–Before Test

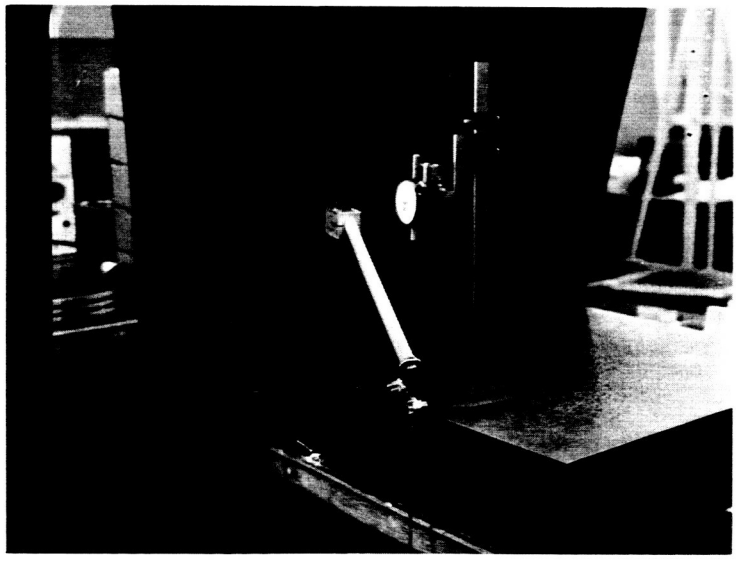


Photo No. 2–After Test

File No. 500-12

RWF	P.E.
CLW	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Boom Deflection

Date of Test: 7 Aug '61

Requested by: R. Forsythe

Performed by: Corbin, Sween

Purpose of Test: To determine ultimate bending stress of fiberglass tubing.

Description of Article Tested (Photographs, if any):

2 pieces fiberglass tubing
a. Young development tube - O.D. = 0.760" I.D. = ?
b. Lamtex material - - - - - O.D. = 0.750" I.D. = 0.425"

Test Equipment (Photographs, if any):

Aluminum block
Dial indicator
Weight pan
Weights "F&M"

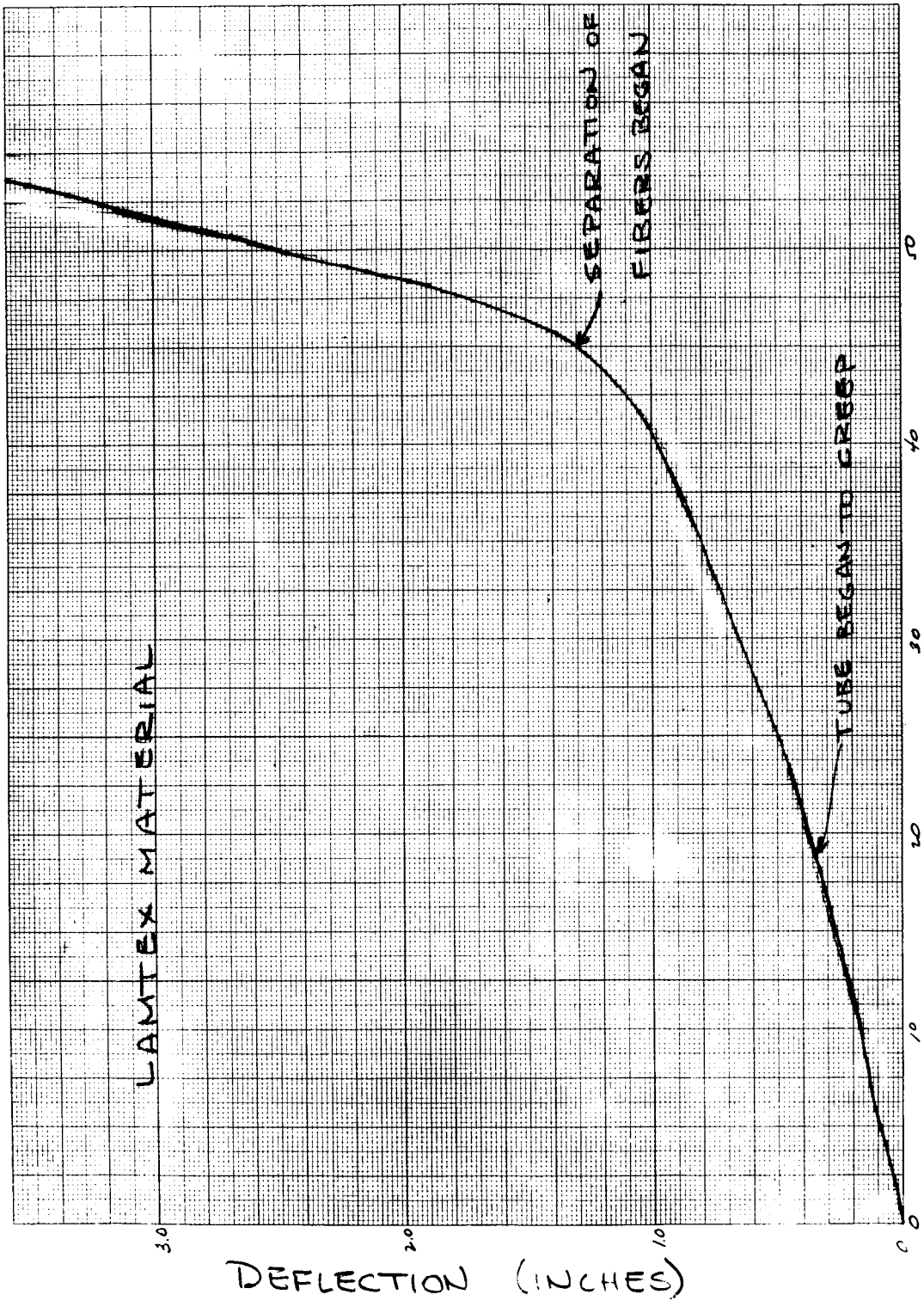
Test Procedure:

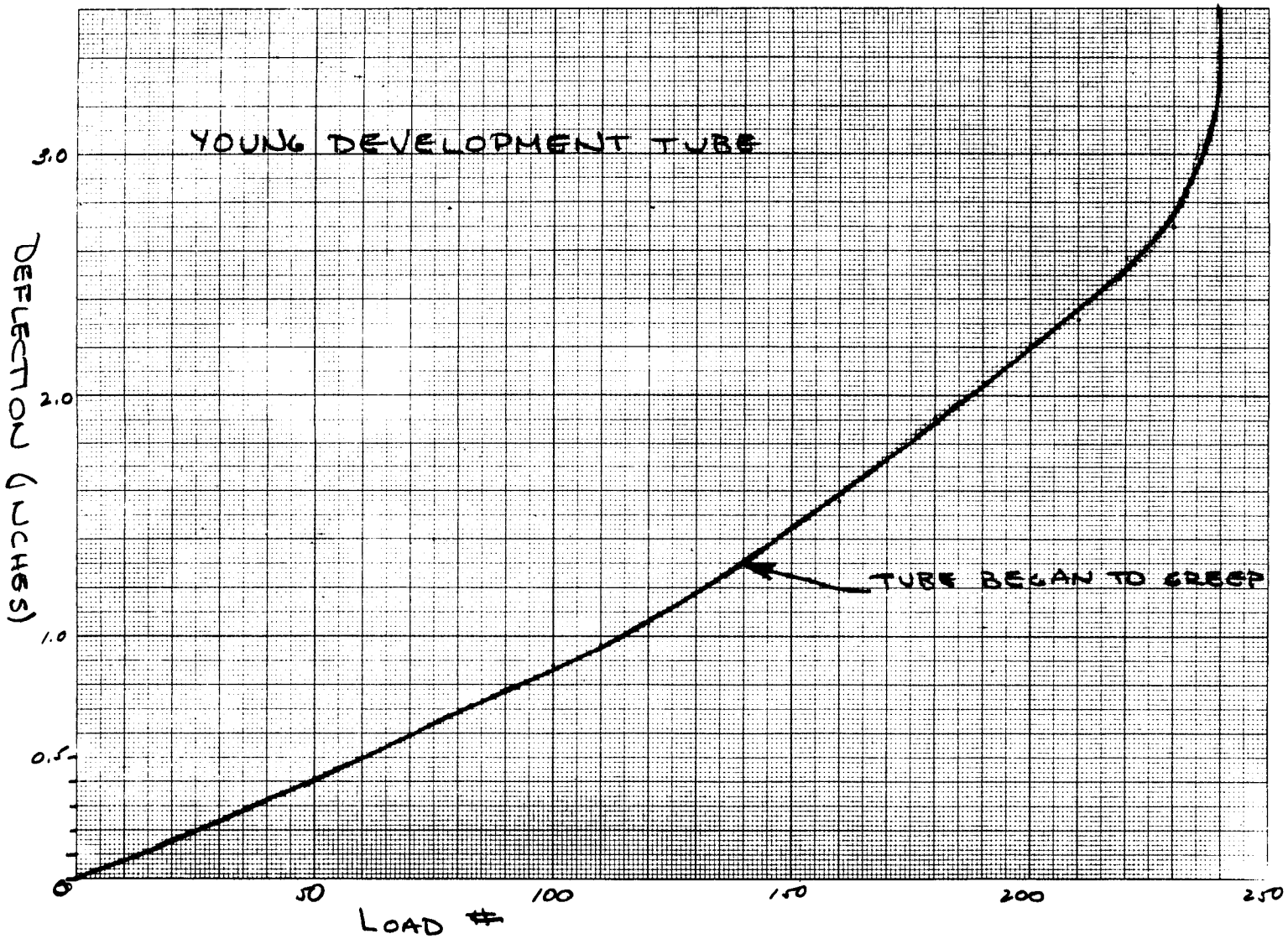
1. Tubing was clamped in aluminum block, and block clamped to A-frame.
2. Plastic cable clamp was fastened over end of tube.
3. Dial indicator set-up to read deflection at 12" from Fulcrum. See SK-1.
4. Load was applied in 1# increments from 0-20# and 5# increments from 20# to failure for Lamtex tube. In 10# increments from 0-10 failure for Young development tube.

Results:

See Data Sheets & Graphs.

Conclusions:


LAMTEX MATERIAL
SEPARATION OF FIBERS BEGAN
TUBE BEGAN TO CREEP
DEFLECTION (INCHES)
LOAD #
3.0
2.0
1.0
0
10
20
30
40
50


YOUNG DEVELOPMENT TUBE
DEFLECTION (INCHES)
3.0
2.0
1.0
0.5
0
50
100
150
200
250
LOAD #
TUBE BEGAN TO CREEP

SHEET _____

YOUNG DEVELOPMENT TUBE

Load	Defl.	No Load
0	.000	.000
10	.075	.000
20	.154	.002
30	.235	.004
40	.322	.008
50	.410	.012
60	.500	.015
70	.590	.018
80	.682	.023
90	.778	.029
100	.880	.036
110	.970	.040
120	1.050	.042
130	1.185	.047
140	1.311	.051 → TUBE CREEPING AS READING WAS
150	1.445	.056 TAKEN.
160	1.558	.062
170	1.720	.068
180	1.905	.068
190	2.050	.068
200	2.205	.068
210	2.310	.065
220	2.570	.075
230	2.700	.079
240	FAILURE	

DATA PAPER (11 COLUMN) PRNC-GEN-66 (REV. 9-53)

NAVY-BUPO PRNC. WASH., D.C.

SHEET_____

LAMTEX MATERIAL

Load	Defl.	No Load	
0	.000	.000	
1	.017	.000	
2	.035	.000	
3	.052	.000	
4	.070	.000	
5	.088	.000	
6	.106	.0015	
7	.123	.0015	
8	.142	.002	
9	.160	.0025	
10	.171	.003	
11	.190	.004	
12	.208	.0045	
13	.226	.0055	
14	.245	.0065	
15	.265	.0075	
16	.286	.0095	
17	.305	.011	
18	.326	.013	
19	.354	.017	→ TUBE CREEPING WHILE READING WAS
20	.380	.025	TAKEN.
25	.488	.037	
30	.702	.049	
35	.835	.066	
40	.942	.110	
45	1.300	.210	→ PERMANENT SEPARATION OF FIBERS
50	2.500	.635	
55	FAILURE		

DATA PAPER (11 COLUMN) PRNC-GEN-66 (REV 9-53)

NAVY-BUPO PRNC, WASH., D.C.

IV - RELEASE MECHANISM

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-30A

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Temperature Qualification of Holex Pressure Cartridge 2855

Date of Test: 21 & 23 Feb '62

Requested by: Wagner

Performed by: Peterson, King, Hunkeler

Purpose of Test: To determine heat transfer to Holex unit under vacuum within 750 sec.

Description of Article Tested (Photographs, if any):

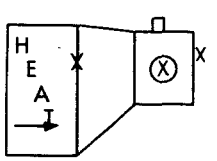
Holex Pressure Cartridge 2855

Test Equipment (Photographs, if any):

CVC Vacuum System
Millivolt Recorder
250-watt Heater

Test Procedure:

1. Holex assembly is mounted on aluminum retainer block.
2. Bottom surface of retainer block is coated with RTV silicone rubber.
3. Entire unit is placed on a 250 watt heater.
4. Attach thermocouples to pinpuller, powder chamber, & heater.
5. Entire assembly was placed in bell jar to a vacuum of 5×10^{-5} mm Hg.
6. After vacuum was obtained voltage was applied to heater until 400°F was reached in 12.5 minutes.
7. Assembly was allowed to soak for 20 minutes at 400°F.



X = Thermocouple Position

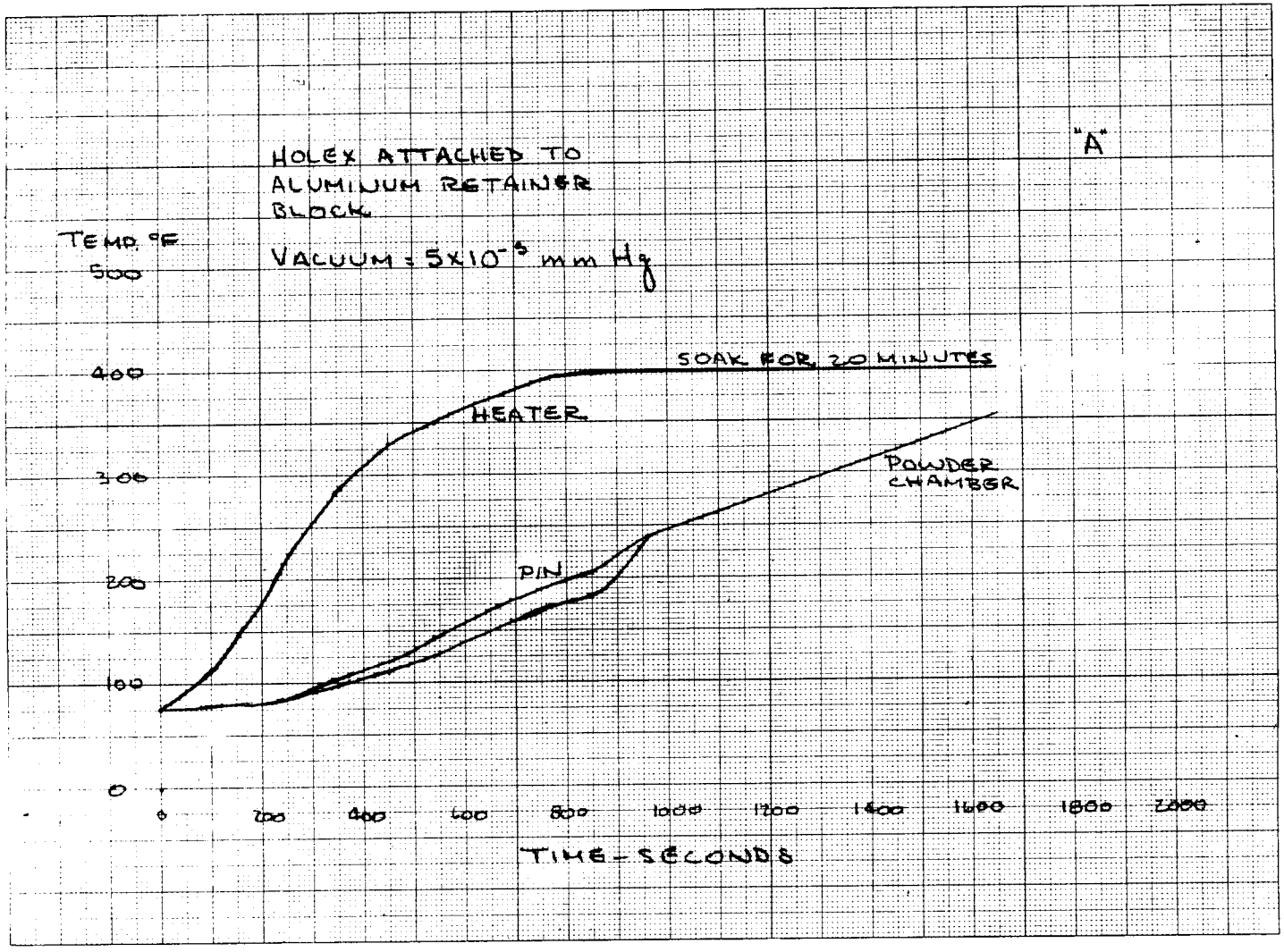
Results:

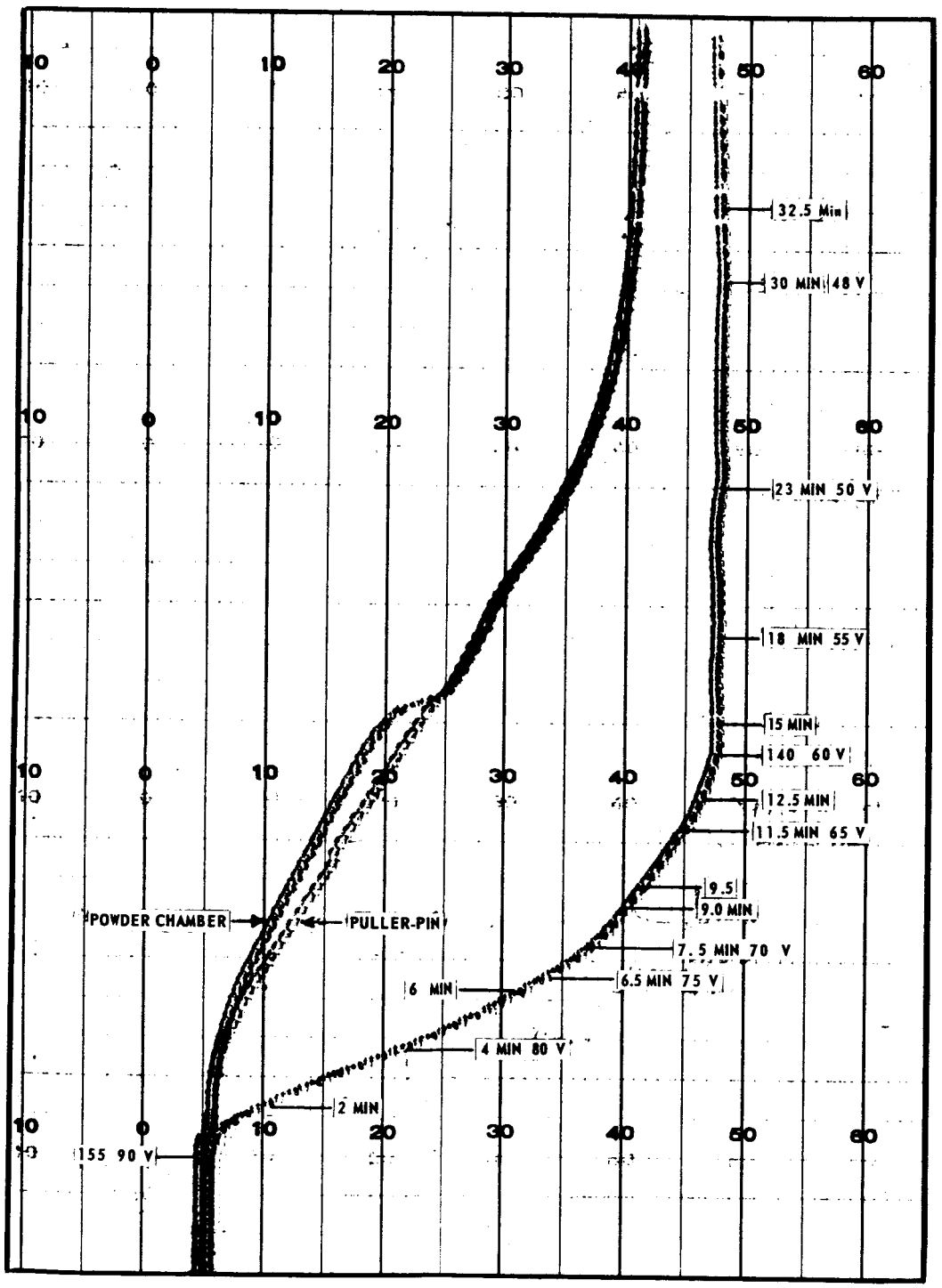
See graphs.

Conclusions:

Results indicate that trial with live squib is needed.

CLW


"A"
HOLEX ATTACHED TO ALUMINUM RETAINER BLOCK
VACUUM = 5X10⁻⁵ mm Hg
TEMP °F
500
400
300
200
100
0
SOAK FOR 20 MINUTES
HEATER
POWDER CHAMBER
PIN
0
200
400
600
800
1000
1200
1400
1600
1800
2000
TIME - SECONDS


32.5 Min
30 MIN 48 V
23 MIN 50 V
18 MIN 55 V
15 MIN
140 60 V
12.5 MIN
11.5 MIN 65 V
9.5
9.0 MIN
7.5 MIN 70 V
6.5 MIN 75 V
6 MIN
4 MIN 80 V
2 MIN
155 90 V
POWDER CHAMBER
PULLER-PIN

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-30B

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Temperature Qualification of Holex. Pressure Cartridge 2855.

Date of Test: 23 Feb. '62

Requested by: Wagner

Performed by: Peterson, King, Hunkeler, Kauffman

Purpose of Test: To determine heat transfer to Holex unit under vacuum within 750 sec.

Description of Article Tested (Photographs if any):

Holex Pressure Cartridge 2855

Test Equipment (Photographs, if any):

CVC Vacuum System
Millivolt Recorder
250-watt Heater
Simpson 362

Test Procedure:

1. Holex assembly is mounted on aluminum retainer block.
2. Bottom surface of block is coated with RTV silicone rubber.
3. Entire unit is placed on 250-watt heater.
4. Thermocouples are attached to heater and Holex case.
5. Entire assembly is placed in bell jar and a vacuum of 5×10^{-5} mm Hg is attained.
6. While under vacuum, voltage is applied to heater until 400°F is reached in 12.5 min.
7. Assembly was soaked at 400°F for 20 min.
8. Squib resistance was measured each time heat was varied.

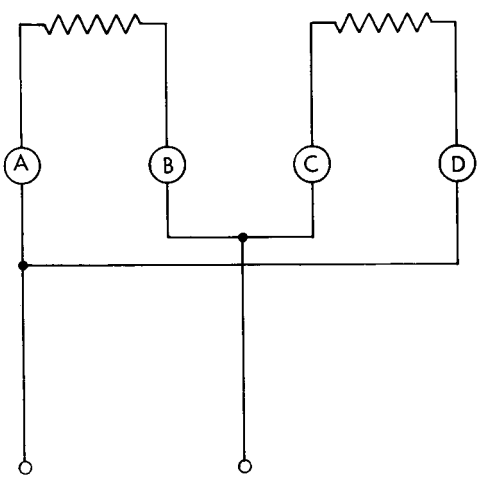
Results:

When the test had run for 30.4 min. and a temperature of 334°F was reached, the powder in the squib unit ignited & exploded.
See Data Sheets.
See Graphs.

Conclusions:

A new system must be devised to support the pin pullers and prevent the pressure cartridge from auto-ignition. We will try changing material to phenolic.

SQUIBS



A-B = 1.31Ω

C-D = 1.30Ω

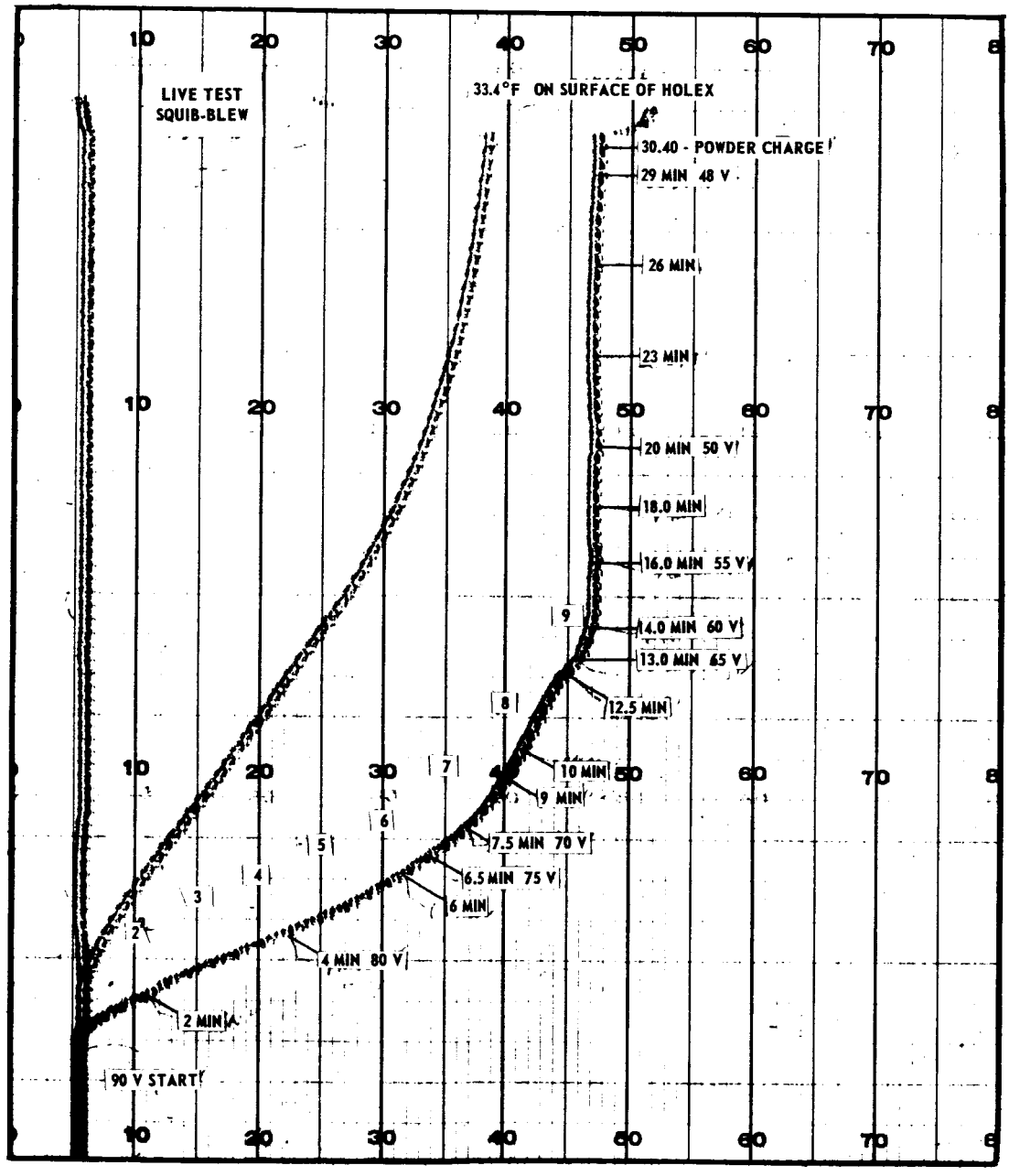
AD-BC = 0.65Ω

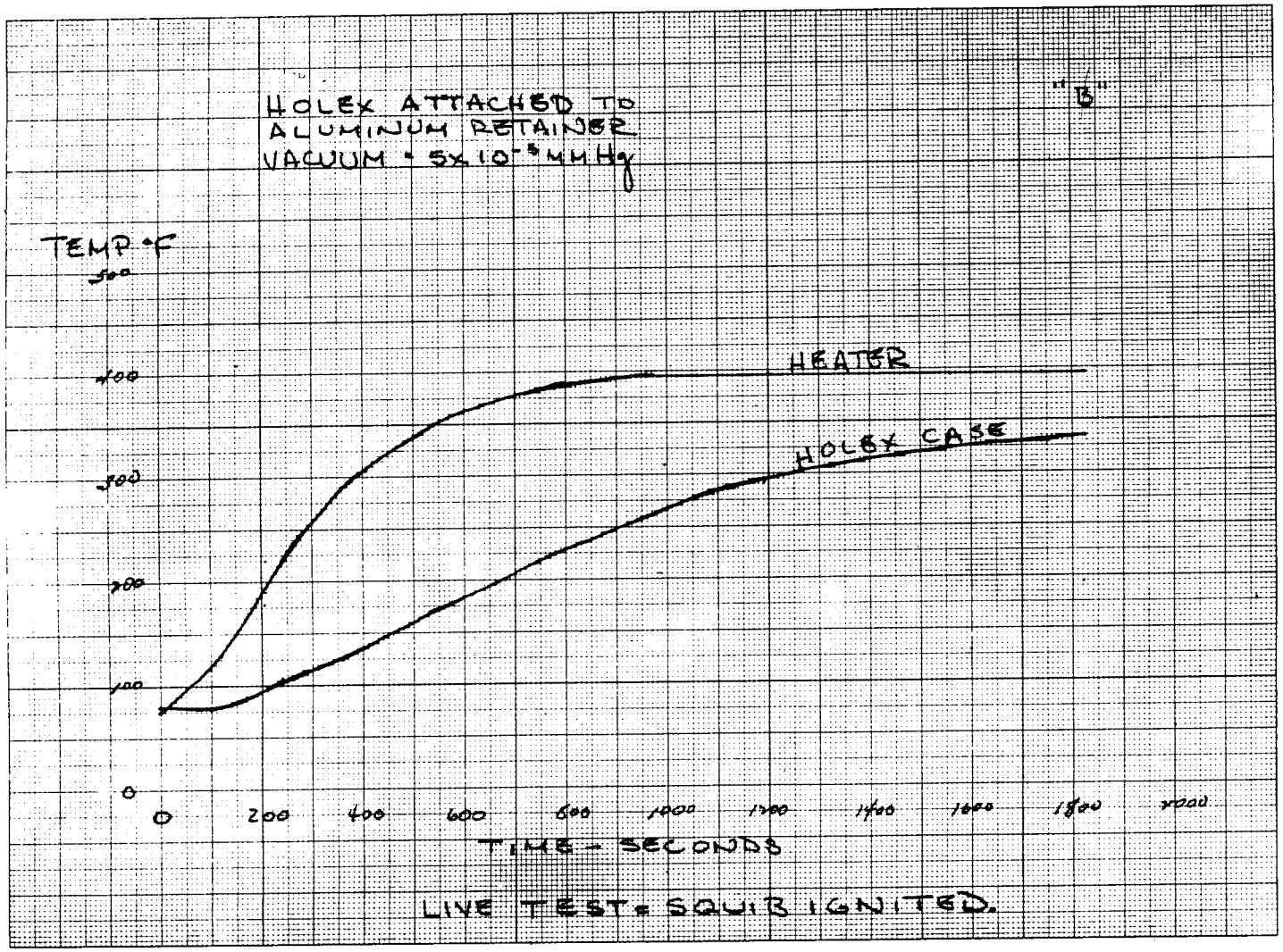
Lead Resistance on Vac. Chamber (CVC)= 0.15Ω

Squib resistance (AD-BC) was taken each time heat was varied.

Resistance remained at 0.8Ω until failure.

Resistance measured on Simpson 362.


LIVE TEST
SQUIB-BLEW
33.4°F ON SURFACE OF HOLEX
30.40 - POWDER CHARGE
29 MIN 48 V
26 MIN
23 MIN
20 MIN 50 V
18.0 MIN
16.0 MIN 55 V
14.0 MIN 60 V
13.0 MIN 65 V
12.5 MIN
10 MIN
9 MIN
7.5 MIN 70 V
6.5 MIN 75 V
6 MIN
4 MIN 80 V
2 MIN
90 V START
10
20
30
40
50
60
70
1
2
3
4
5
6
7
8
9


HOLEX ATTACHED TO
ALUMINUM RETAINER
VACUUM = 5x10⁻⁵ MM Hg
"B"
TEMP °F
500
400
300
200
100
0
HEATER
HOLEX CASE
0
200
400
600
800
1000
1200
1400
1600
1800
2000
TIME - SECONDS
LIVE TEST - SQUIB IGNITED.

SHEET_____

HOLEX CASE ATTACHED TO ALUMINUM RETAINER

HEATER					HOLEX-CASE					
Time	Voltage	Temp.			Time	Voltage	Temp.			
Sec	MV	°F			Sec	MV	°F			
0	1.0	78			0	1.0	78			
120	2.2	129			120	1.1	82			
240	4.5	221			240	1.6	104			
360	6.4	292			360	2.1	125			
540	8.0	348			540	3.2	170			
780	9.0	386			780	4.6	225			
960	9.39	395			960	5.6	262			
1200	9.39	395			1200	6.59	298			
1560	9.39	395			1560	7.3	324			
1740	9.39	395			1740	7.5	331			
1824	9.4	396			1824	7.6	334			

	Time		Pressure		Ohms		Voltage
	4:42		Start Pump		0.8		Off
	5:00		2.5×10^{-4}		0.8		Off
	5:15		1.6×10^{-4}		0.8		Off
	5:25		1.3×10^{-4}		0.8		90V (ON)
	5:29		1.3×10^{-4}		0.8		80V
	5:31		1.3×10^{-4}		0.8		75V
	5:32		1.6×10^{-4}		0.8		70V
	5:37		2×10^{-4}		0.8		70V
	5:38		2×10^{-4}		0.8		65V
	5:39		2.5×10^{-4}		0.8		60V
	5:41		2×10^{-4}		0.8		55V
	5:45		1.6×10^{-4}		0.8		50V
	5:50		1.4×10^{-4}		0.8		50V
	5:54		1.2×10^{-4}		0.8		48V

30 MIN + 40 SECS SQUIB EXPLODED
TEMP OF HOLEX CASE WAS 334 °F

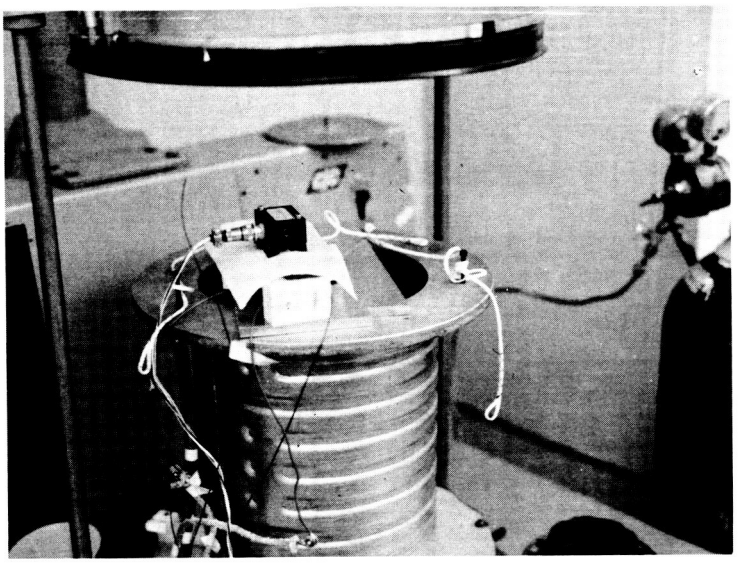


Photo No. 1–Holex Pressure Cartridge 2855

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-30C

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Temperature Qualification of Holex. Pressure Cartridge 2855.

Date of Test: 23 Feb. '62

Requested by: Carl Wagner

Performed by: Peterson, King, Hunkeler

Purpose of Test: To determine heat transfer to Holex unit under vacuum within 750 sec.

Description of Article Tested (Photographs, if any):

Holex pressure cartridge is used in pin pullers and is loaded with pistol powder. The unit tested was a fired cartridge with thermocouples located as in diagram. See SK-1.

Test Equipment (Photographs, if any):

CVC Vacuum System
Millivolt Recorder
250-watt Heater

Test Procedure:

1. Holex assembly was mounted on a 1/2" block of cloth laminated phenolic.
2. Entire unit was placed on a 250-watt heater.
3. Thermocouples were attached to heater, pin puller, & powder chamber.
4. Entire assembly was placed in bell jar and a vacuum of 5×10^{-5} mm Hg was attained.
5. After vacuum was established, voltage was applied to heater until temperature of 400°F was reached in 12.5 minutes.
6. Assembly was allowed to soak at 400°F for 20 minutes.

Results:

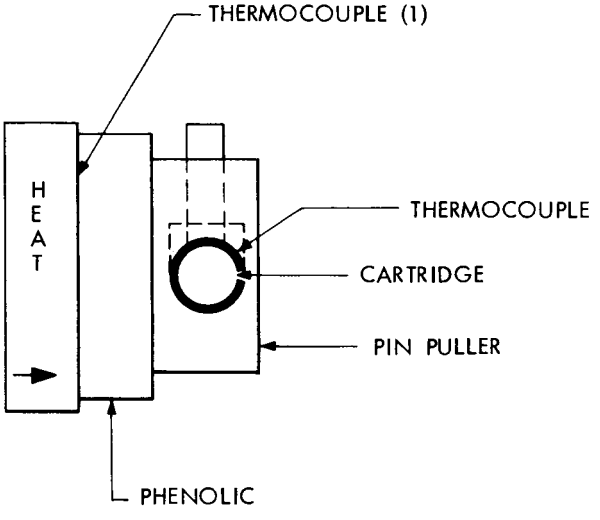
See Graphs & Data Sheet.

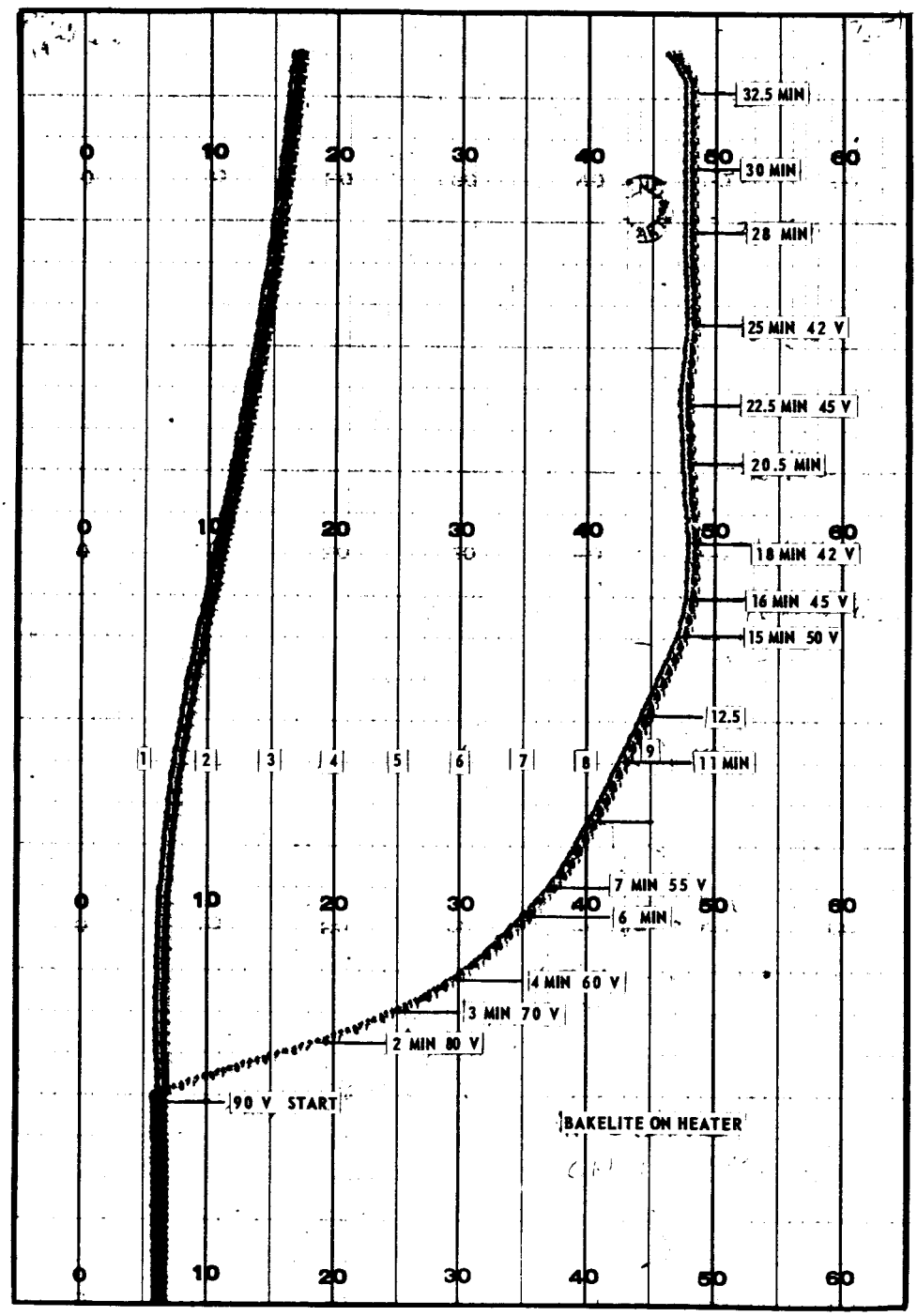
Conclusion:

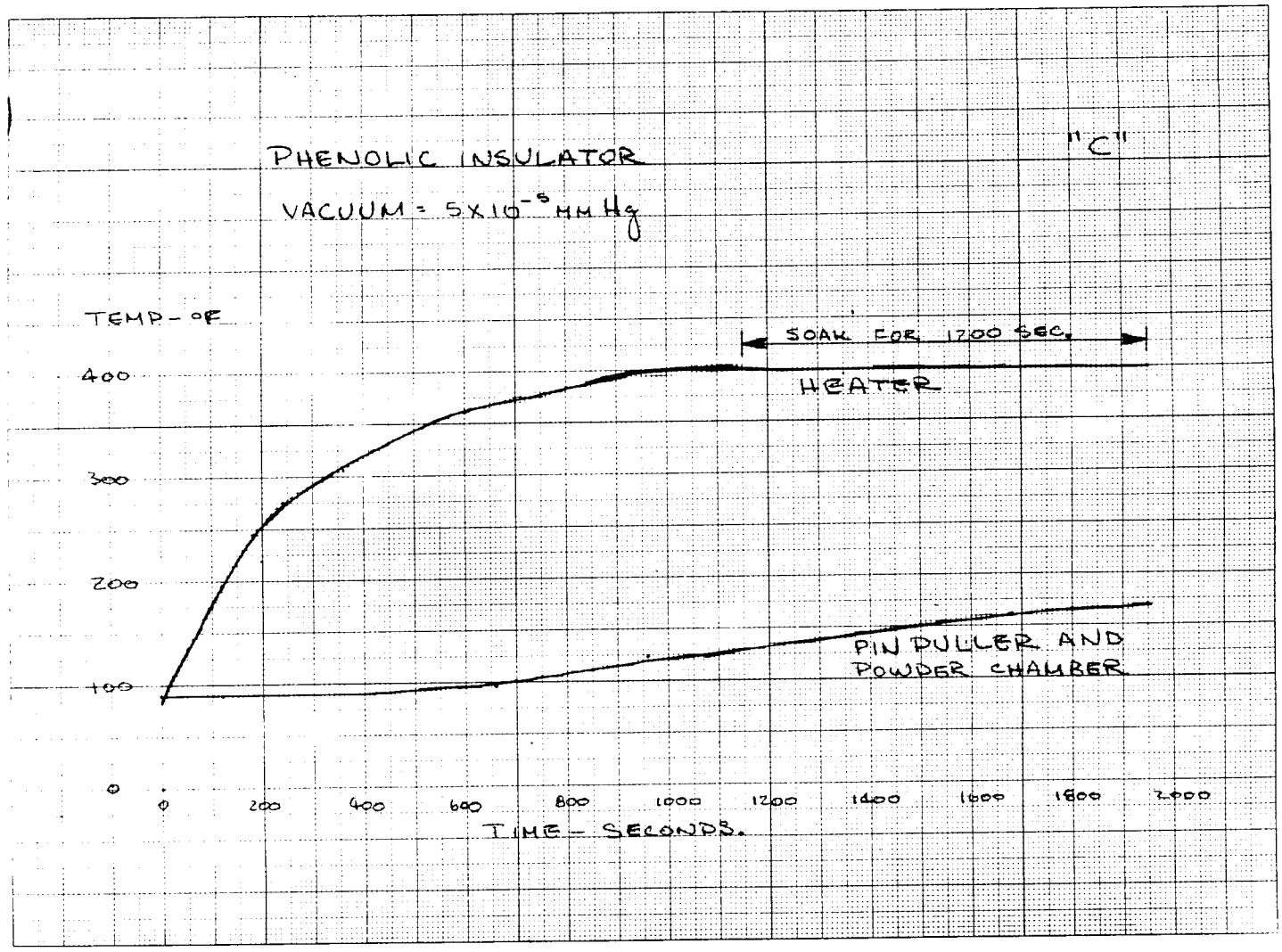
See Test Report #500-30D.
After 20 min. soak at 400°F at thermocouple (1) temperature in pin puller cartridge reached only 170°F. O.K. to try line test.

CLW

SK - 1


THERMOCOUPLE (1)
HEAT
THERMOCOUPLE
CARTRIDGE
PIN PULLER
PHENOLIC


32.5 MIN
30 MIN
28 MIN
25 MIN 42 V
22.5 MIN 45 V
20.5 MIN
18 MIN 42 V
16 MIN 45 V
15 MIN 50 V
12.5
11 MIN
7 MIN 55 V
6 MIN
4 MIN 60 V
3 MIN 70 V
2 MIN 80 V
90 V START
BAKELITE ON HEATER
0
10
20
30
40
50
60
1
2
3
4
5
6
7
8
9


PHENOLIC INSULATOR
VACUUM = 5X10⁻⁵ MM Hg
"C"
TEMP - °F
SOAK FOR 1200 SEC.
HEATER
400
300
200
100
PIN PULLER AND
POWDER CHAMBER
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
TIME - SECONDS.

SHEET

	HEATER			HOLEX	
Time	Voltage	Temp.	Time	Voltage	Temp.
Sec.	MV	°F	Sec.	MV	°F
0	1.1	82	0	1.2	87
120	3.85	196	120	1.2	87
180	5.1	244	180	1.2	87
240	6.0	277	240	1.2	87
360	7.0	313	360	1.2	87
420	7.4	327	420	1.24	88
540	8.1	352	540	1.39	95
660	8.5	366	660	1.45	97
750	8.8	376	750	1.6	104
900	9.4	396	900	1.8	113
960	9.5	400	960	2.0	121
1080	9.6	403	1080	2.1	125
1230	9.45	397	1230	2.3	134
1350	9.4	396	1350	2.5	142
1500	9.5	400	1500	2.7	150
1680	9.5	400	1680	3.0	162
1800	9.5	400	1800	3.1	166
1950	9.5	400	1950	3.2	170

THERMOCOUPLES ON PIN PULLER AND POWDER CHAMBER

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-30D

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Temperature Qualification of Holex Pressure Cartridge 2855

Date of Test: 24 Feb '62

Requested by: Wagner

Performed by: Peterson, King, Kauffman, Hunkeler

Purpose of Test: To determine heat transfer to Holex unit under vacuum within 750 sec.

Description of Article Tested (Photographs, if any):

Holex Pressure Cartridge 2855

Test Equipment (Photographs, if any):

CVC Vacuum System
Millivolt Recorder
250-watt Heater

Test Procedure:

1. Holex assembly is mounted on a 1/2" block of cloth inserted bakelite.
2. The entire unit is placed on a 250-watt heater.
3. Thermocouples are attached to heater and surface of Holex assembly.
4. Entire assembly is placed in bell jar to a vacuum of 5×10^{-5} mm Hg.
5. When vacuum is established voltage is applied to heater until 400°F is reached in 12.5 minutes.
6. Allowed to soak at 400°F for 20 minutes.
7. Squib resistance was checked before test only.

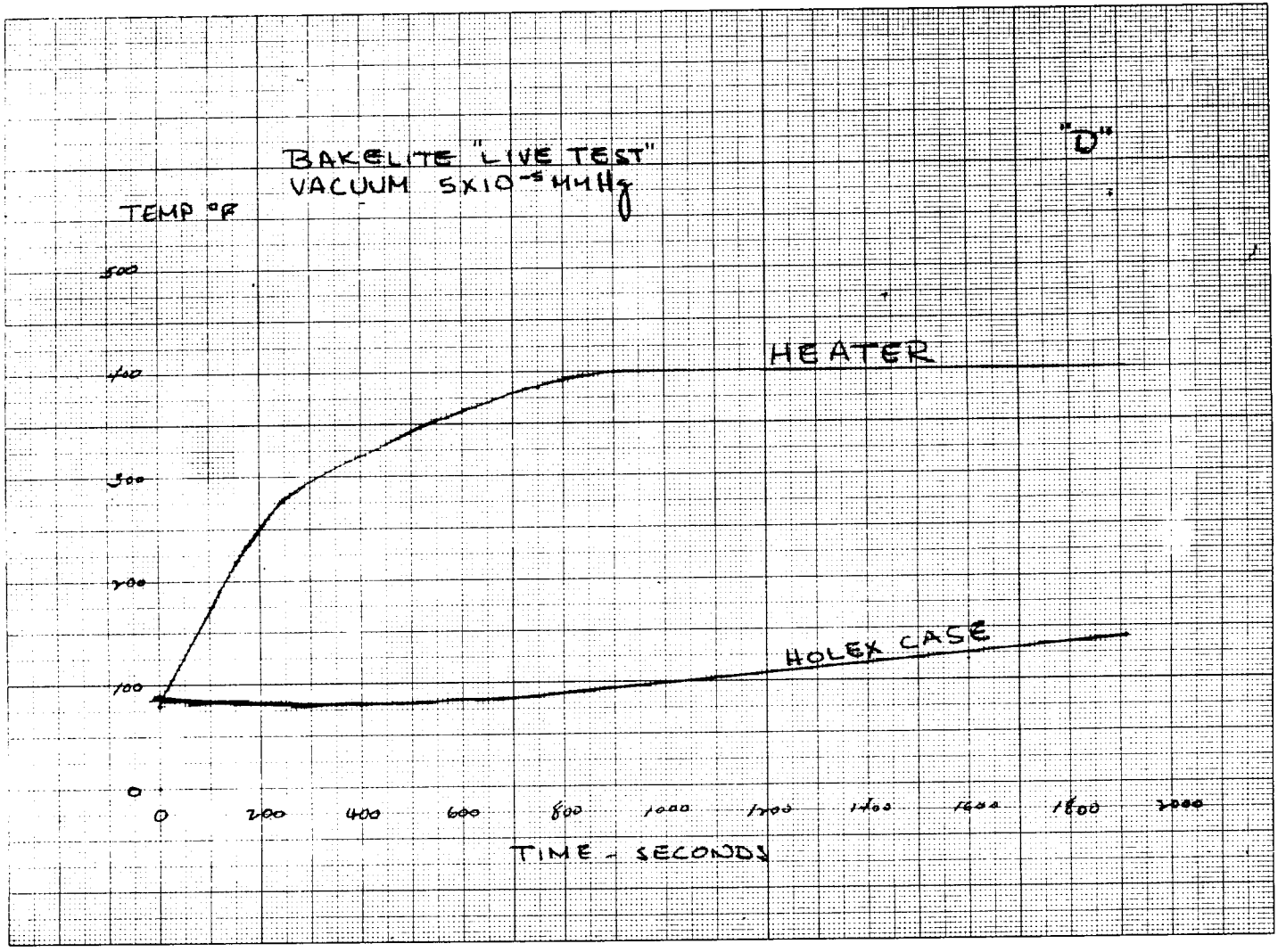
Results:

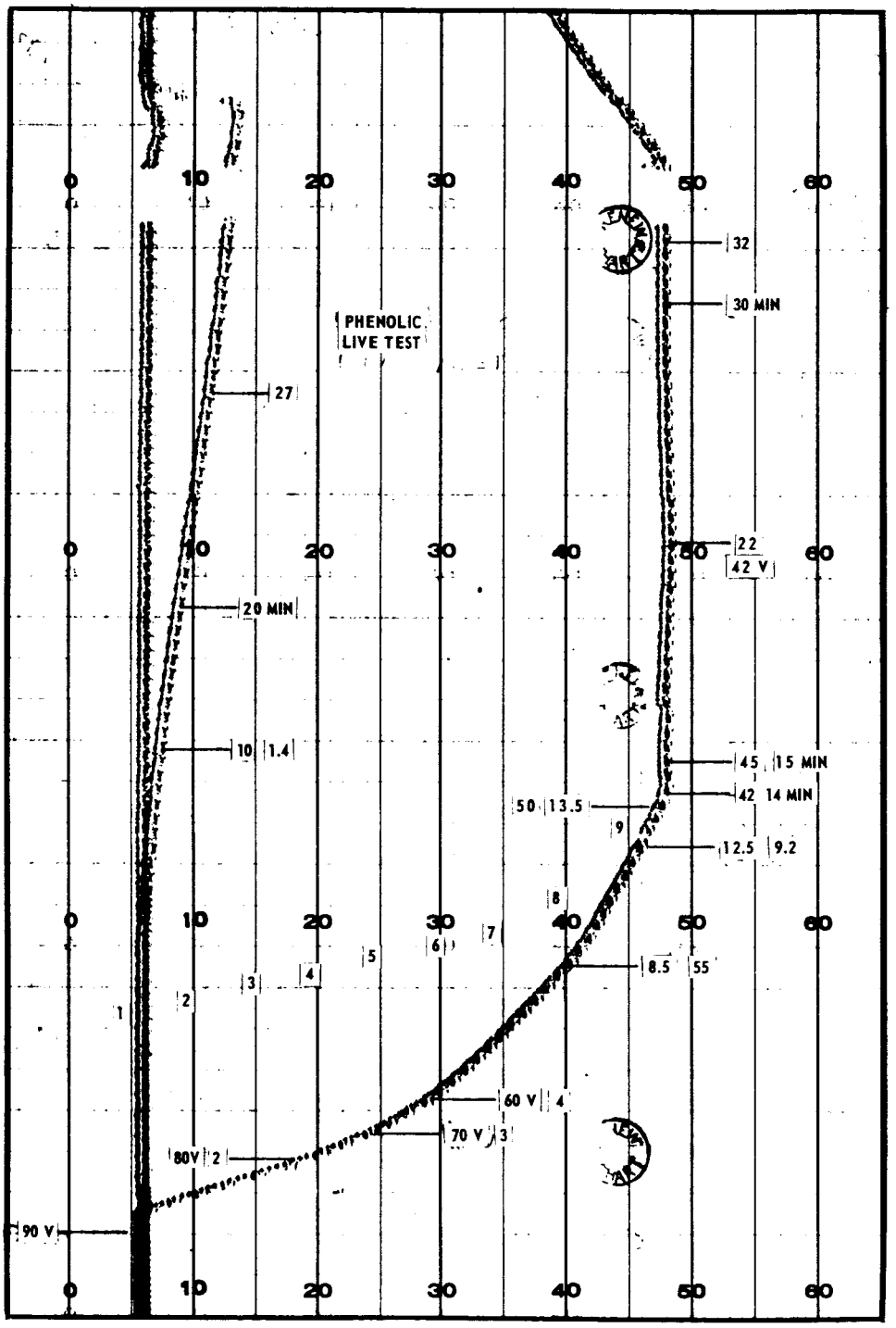
See Data Sheets & Graphs.

Conclusions:

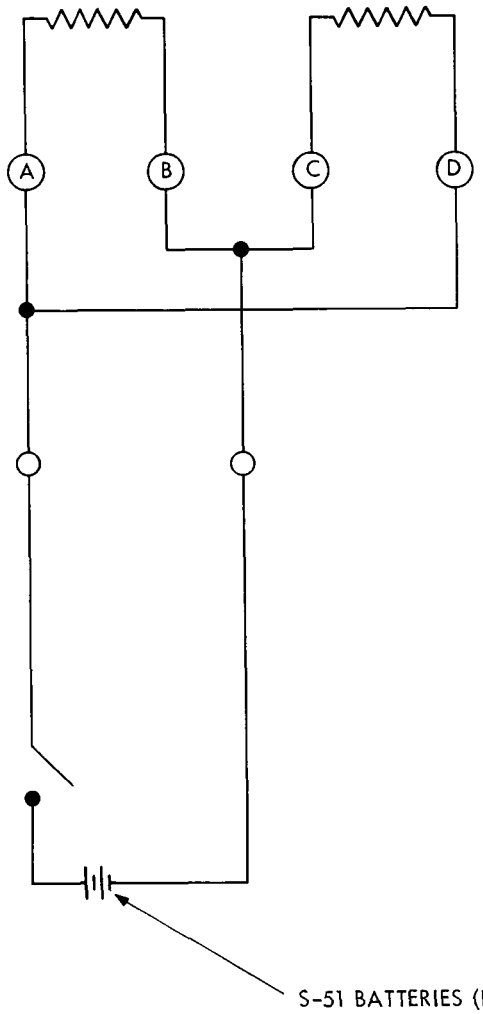
After changing to phenolic and soaking the system as per chart for 20 minutes (coast time plus) the cartridge was successfully fired under load. Two tests were made: This one and 500-34. The cartridge is now considered safely temperature protected.

CLW


BAKELITE "LIVE TEST"
VACUUM 5X10⁻⁵ MM Hg
"D"
TEMP °F
500
400
300
200
100
0
HEATER
HOLEX CASE
0
200
400
600
800
1000
1200
1400
1600
1800
2000
TIME - SECONDS


PHENOLIC
LIVE TEST
32
30 MIN
27
22
42 V
20 MIN
10
1.4
45
15 MIN
42
14 MIN
50
13.5
9
12.5
9.2
8.5
55
60 V
4
70 V
3
80V
2
90 V

SQUIBS



A-B = 1.33Ω

C-D = 1.31Ω

AD-BC = 0.68Ω

Battery Voltage = 14 DC

Squib Resistance
check before test only.

Resistance measured on
on Simpson 362

SHEET _____

BAKELITE LIVE TEST

	HEATER			HOLEX-CASE	
Time	Voltage	Temp.	Time	Voltage	Temp.
Sec.	MV	°F	Sec.	MV	°F
0	1.1	82	0	1.1	82
120	3.7	190	120	1.1	82
180	4.9	236	180	1.1	82
240	5.9	273	240	1.1	82
510	8.0	348	510	1.1	82
750	9.1	386	750	1.2	87
840	9.45	397	840	1.24	88
1320	9.5	400	1320	1.8	113
1800	9.43	397	1800	2.39	137
1920	9.43	397	1920	2.41	138

DATA PAPER (11 COLUMN) PRNC-GEN-66 (Rev. 9-53)

NAVY-BUPO PRNC, WASH., D.C.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-34

CLW	P.E.
JTS	S.H.
RCB	B.H.

Name of Test: Determination of Electrical Energy to Fire Holex Squib under Simulated Flight Conditions

Date of Test: 28 Feb. '62

Requested by: Carl Wagner

Performed by: Kauffman, King, Peterson, Mandell

Purpose of Test: To measure voltage & current of Holex after vacuum & heat for 32.5 min.

Description of Article Tested (Photographs, if any):

Holex Pressure Cartridge 2855

Test Equipment (Photographs, if any):

CVC Vacuum System
Millivolt Recorder
Dual Scope with camera
Test Firing Rig

Test Procedure:

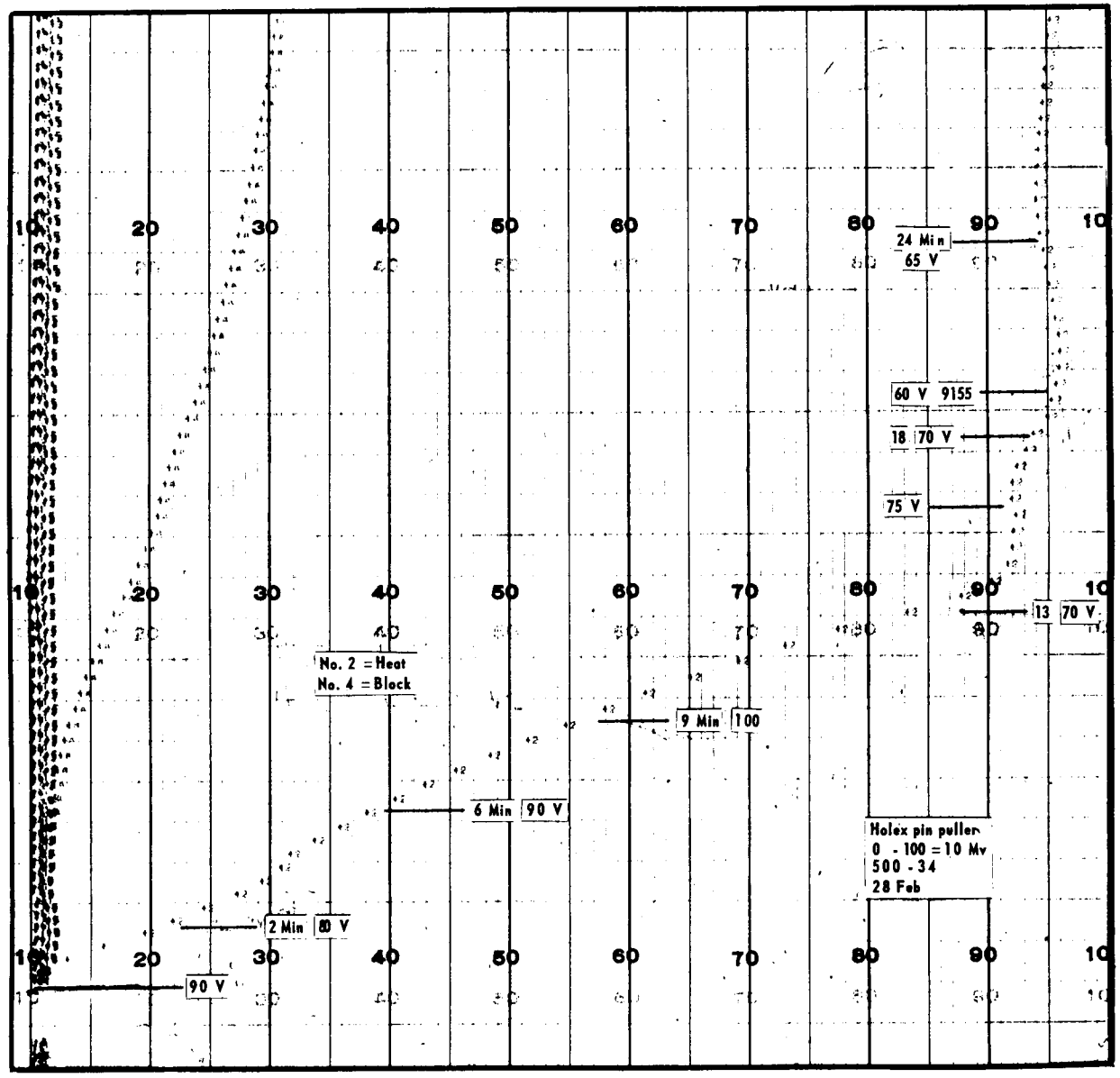
1. Holex assembly is mounted to a 1/2" block of cloth inserted bakelite phenolic.
2. Entire unit is placed on a 250-watt heater.
3. Attach thermocouple to heater & Holex case.
4. Place entire assembly under vacuum of 10^{-4}.
5. 400°F obtained in 12.5 min.
6. Soak for 20 min. at 400°F.
7. Heat cut off after bell jar reached atmosphere.
8. Holex removed and placed on preheated 200°F plate.
9. Nylon cords attached with 60# load on each side.
10. When Holex pin puller was fired, a scope-camera combination took picture of current & voltage. (See sketch of data from picture).

Results:

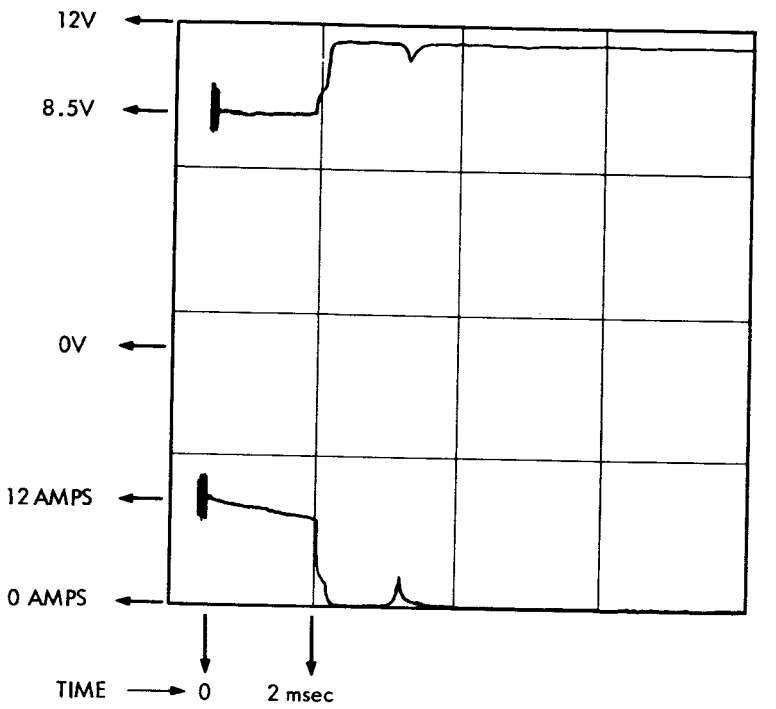
Conclusions:

The battery pack supplied to fire the squibs will not be drained by the 12 amp drain since it lasts only 2 milliseconds. The voltage drops to 8.5 volts which is also an acceptable level.

CLW


No. 2 = Heat
No. 4 = Block
90 V
2 Min 80 V
6 Min 90 V
9 Min 100
24 Min
65 V
60 V 9155
18 70 V
75 V
13 70 V
Holex pin puller
0 - 100 = 10 Mv
500 - 34
28 Feb

SKETCH OF DATA FROM PICTURE



20 AMPS/CM

5 V/CM

2 msec/CM

A - B = 1.23Ω

C - D = 1.30Ω

A - D + B - C = 0.62Ω

A = Orange

B = White

C = Yellow

D = Black

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-40

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Pin-Puller Thrusting Effects

Date of Test: 22 June '62

Requested by: C. L. Wagner

Performed by: J. Sween, W. Flatley

Purpose of Test: To visually observe the thrusting effects of pin puller

Description of Article Tested (Photographs, if any):

Holex 2792 Assembly

Test Equipment (Photographs, if any):

Power source
Test fixture. See SK-1.

Test Procedure:

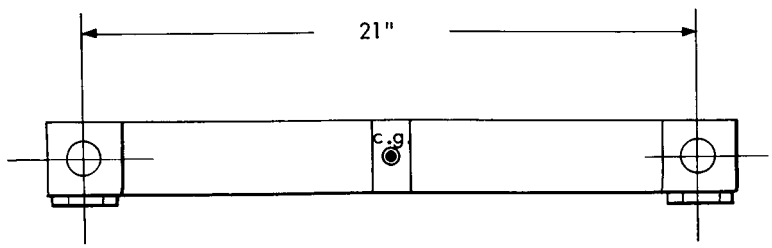
1. Test fixture made as per sketch and wired as shown in wiring diagram.
2. Fixture was hung from A-frame with nylon lacing cord attached to c.g. of fixture.
3. Switch was thrown and results of squib firing observed.
4. Wt. of entire fixture assembly was 474.7

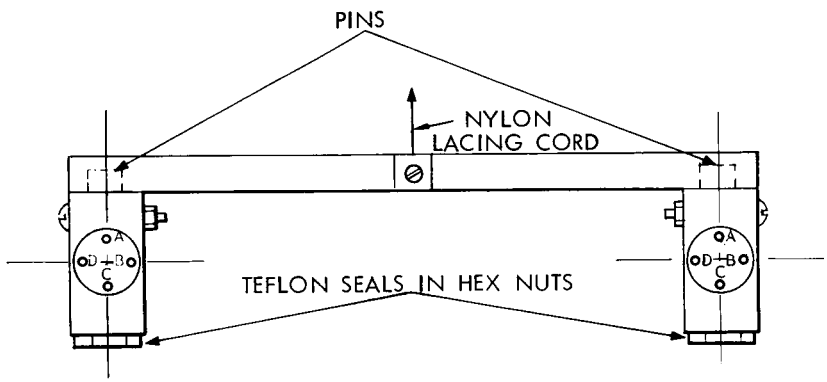
Results:

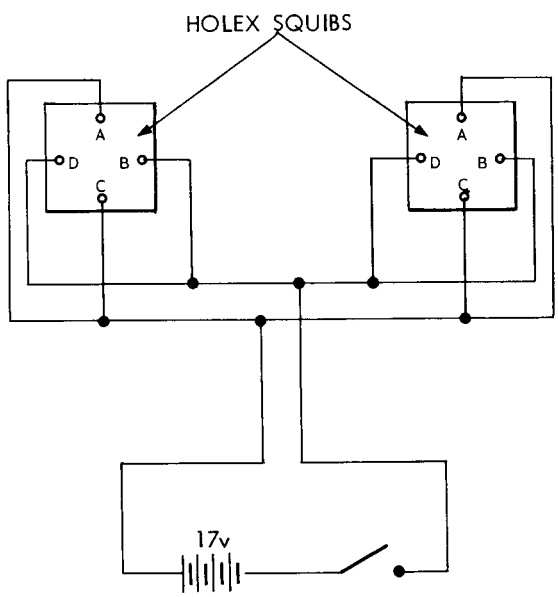
Test was visually observed. When the squibs fired the test fixture lifted approximately 1/4". As far as could be seen the fixture seems to rise evenly on both sides. Teflon seals blew out.

Conclusions:

The above test was conducted in atmospheric conditions, however, vacuum conditions should not create any change in results. No side or horizontal motion occurred. Any effect of the .26 in-lb. of energy would have been to increase the forward velocity of the S-51-X-248 combination on which the pin pullers were used. No increase in coneing $\frac{1}{2}$ could have been attributed to the firing of the pin pullers.


21"
c.g.


PINS
NYLON
LACING CORD
A
D
B
C
TEFLON SEALS IN HEX NUTS


HOLEX SQUIBS
A
D
B
C
17v

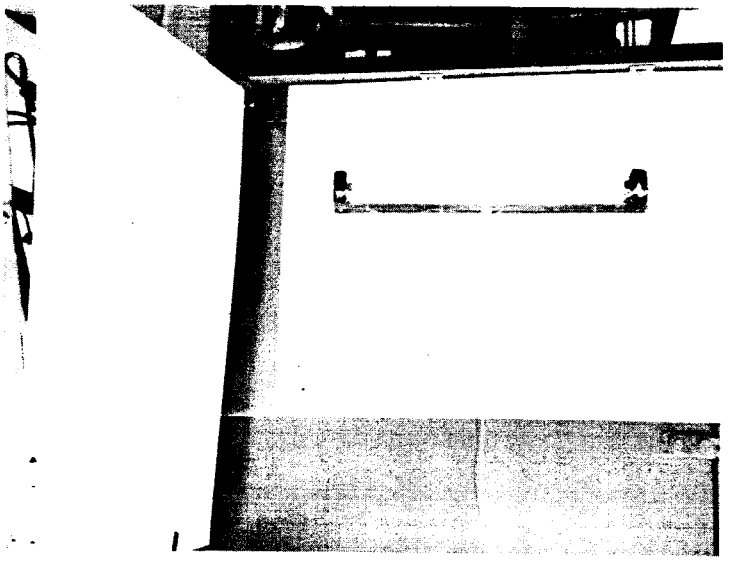


Photo No. 1–Test Fixture

V – NYLON CORD

File No. 500-41

CLW	P.E.
JTS	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH

SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Nylon Cord Thermal-Tension Test

Date of Test: 18-21 June '62

Requested by: Carl Wagner

Performed by: Wall, Kocher

Purpose of Test: To determine amount of nylon cord stretching or its breaking point while applying constant 80# tension and variable heat.

Description of Article Tested (Photographs, if any):

Nylon cord with knotted loops. 54-1/16" long.
Nylon cord with sewn loops. 49-1/2 long.

Test Equipment (Photographs, if any):

1. Ten MV Recorder
2. A-Frame
3. Thermocouples
4. Stop watch
5. 2 Variacs
6. .001" Aluminum Foil
7. Tensiometer
8. 3 Heat Lamps
9. 80# Lead Weights
10. Turnbuckles

Test Procedure:

Tests 1-15 were conducted with set-up "A".
Tests 16-32 were conducted with set-up "B".
See SK-1 for set-ups.

General Procedure for all test runs:

1. Tin foil was placed 1/4" behind nylon cord to insure an even heat on both sides of cord.
2. Turnbuckles were used to bring cord to proper tension of 80# in Tests 16-32.

Results: See attached sheets.

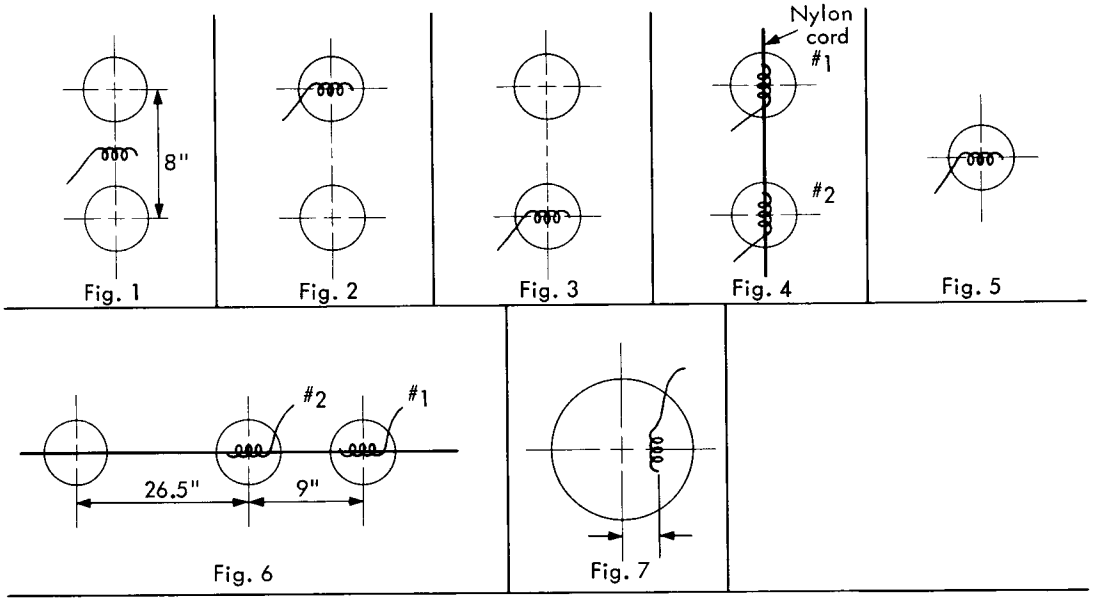
Conclusions:

a. General results were as anticipated with cord temperature increasing with lamps closer to cord.
b. Since cords were not broken it has been shown that temperature ranges used on the cord do not cause fiber breakdown as was anticipated. Maximum temperature reached was 296°F.
c. Considering the effects in the period from 0 to 60 seconds we have:
   The average temperature rise rate on the outside of cord is twice the inside temperature rise rate.
d. Temperature rise rate in cord from 0 to 45 seconds (time during which heat was applied) averaged .05#/sec.
e. Cord temperature decreased from original value after heat was turned off.
f. A new set-up is needed to produce enough heat to break string in 45 to 100 seconds.

Test #	*X-distance (in.)	Temperature Peaks (°F)		Heat Time (sec)	Soak Time (sec)	Reading After Ht.	Reading After SK.	Thermocouple Positioning (See SK-1)	Remarks
		#1	#2			Length	Length		
1	11	84		45	D	D	D	Fig. 1	TESTS 1-8 WERE RUN WITHOUT CORD TO FIND TEMPERATURES PRODUCED WITH THERMOCOUPLES IN VARIOUS POSITIONS WITH RESPECT TO LAMPS
2	11	82		50	D	D	D	Fig. 3	
3	5	111		45	D	D	D	Fig. 2	
4	5	93		45	D	D	D	Fig. 1	
5	3/4	116		45	D	D	D	Fig. 3	
6	3/4	140		45	D	D	D	Fig. 2	
7	1/4	180		30	D	D	D	Fig. 2	
8	0	261		45	D	D	D	Fig. 3	
9	6	134	111	45	60	54-3/32"	NR	Fig. 4	TESTS 9-15 WERE SET-UP AS IN SET-UP "A" IN SK-2. TESTS 9-22 WERE RUN USING NYLON CORD WITH KNOTTED LOOPS. IN RUNS #16 & #18 THE KNOTS SLIPPED
10	6	151	116	45	60	54-1/32"	NR	Fig. 4	
11	3	204	148	45	60	54-9/64"	NR	Fig. 4	
12	2	204	169	45	60	54-1/32"	54-3/32"	Fig. 4	
13	1	250	209	45	60	53-63/64"	54-3/64"	Fig. 4	
14	1/2	260	203	45	60	54"	54-1/16"	Fig. 4	
15	1/4	360	238	45	60	53-31/32"	54-1/8"	Fig. 4	
						Tension	Tension		
16	6	134	111	45	60	80#	80#	Fig. 6	TESTS 16-31 WERE SET-UP AS IN SET-UP "B" IN SK-2
17	4	145	134	45	60	80	79-1/2#	Fig. 6	
18	3	174	171	45	60	80	NR	Fig. 6	
19	2	192	180	45	60	77-1/2	78-3/4#	Fig. 6	

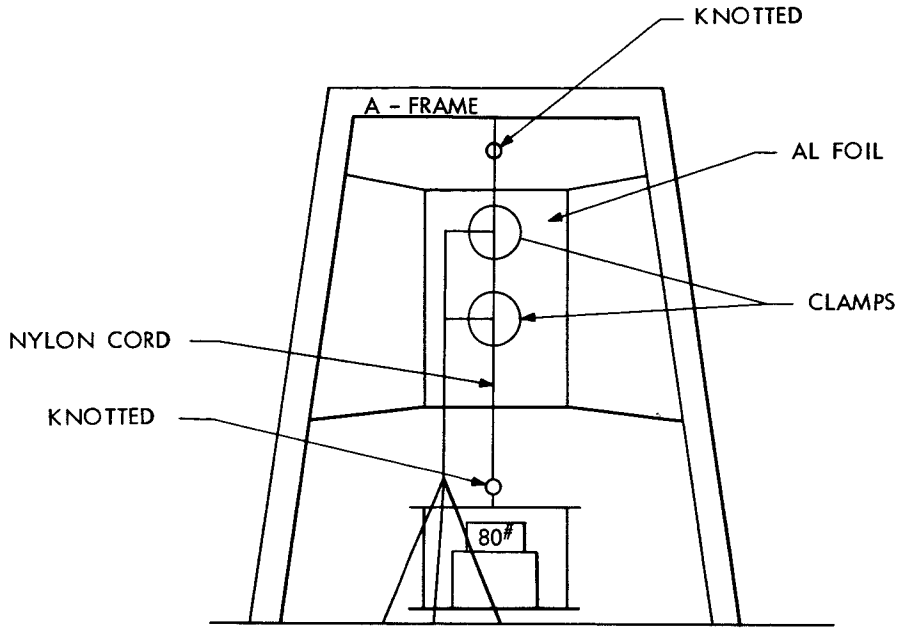
Test #	*X-distance (in.)	Temperature Peaks (°F)		Heat Time (sec)	Soak Time (sec)	Reading After Ht. Tension	Reading After SK. Tension	Thermocouple Positioning (See SK-1)	Remarks
		#1	#2						
20	1	238	215	45	60	80	78	Fig. 6	
21	1/2	241	203	45	60	82	78	Fig. 6	
22	1/4	299	232	45	60	82	77-1/2	Fig. 6	
23	6	SEE GRAPH I FOR TEMPER-ATURES		45	60	D	D	Fig. 6	TESTS 23-31 WERE RUN USING A NEW NYLON CORD WITH EYE SPLICES INSTEAD OF KNOTS AT EITHER END
24	3			45	60	D	D	Fig. 6	
25	1			45	60	D	D	Fig. 6	
26	3	195	150	45	60	79-1/2	78-3/4	Fig. 6	
27	1	244	174	45	60	81-1/4	78	Fig. 6	
28	1/2	285	218	45	60	82	80	Fig. 6	IN TESTS #23, #24, AND #25 T.C. POSITION ON CORD WAS VARIED IN 1" INCREMENTS FROM 0-17." AT EACH INCREMENT LAMPS WERE ON FOR 45 SEC & OFF FOR 60 SEC
29	1/4	296	227	45	60	83	81	Fig. 6	
30	1/4	360	267	120	60	82-1/2	77-1/2	Fig. 6	
31	1/4	418	302	600	60	87-1/2	73-1/2	Fig. 6	
32	1	273		300	D	D	D	Fig. 5	
33	0	487		300	D	D	D	Fig. 7	IN TEST #32 T.C. WAS ATTACHED TO AL FOIL. IN TEST #33 T.C. WAS ATTACHED TO FACE OF LAMP

*X-Distance is always distance from lamp to thermocouple
D - Does Not Apply
NR - No Reading

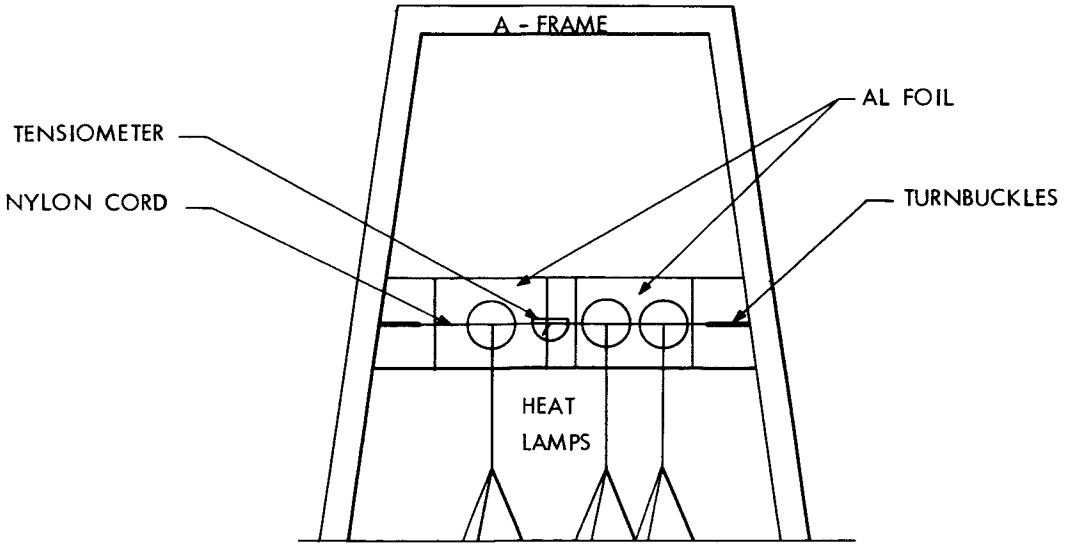


SK-1 Thermocouple Positioning

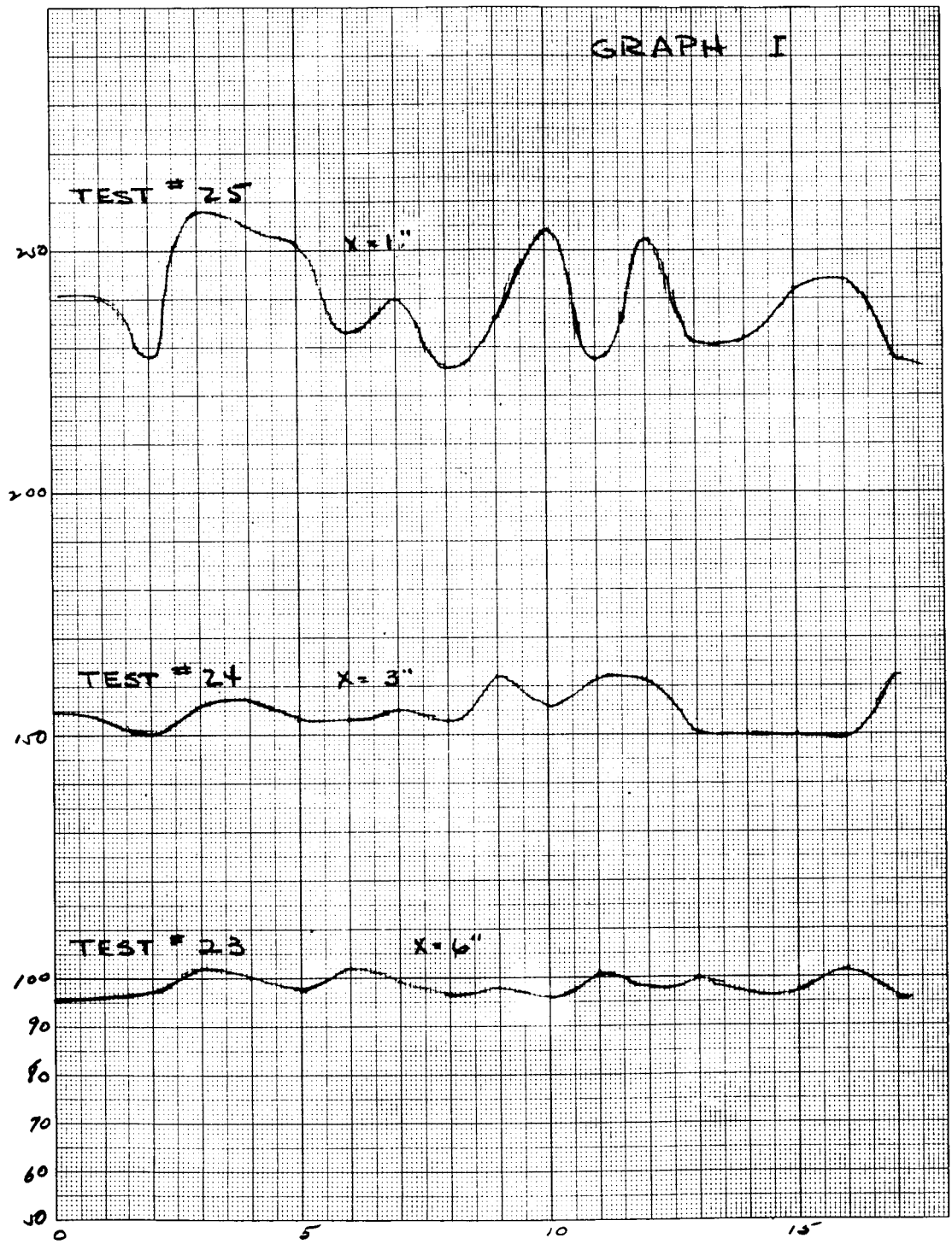
SK - 2

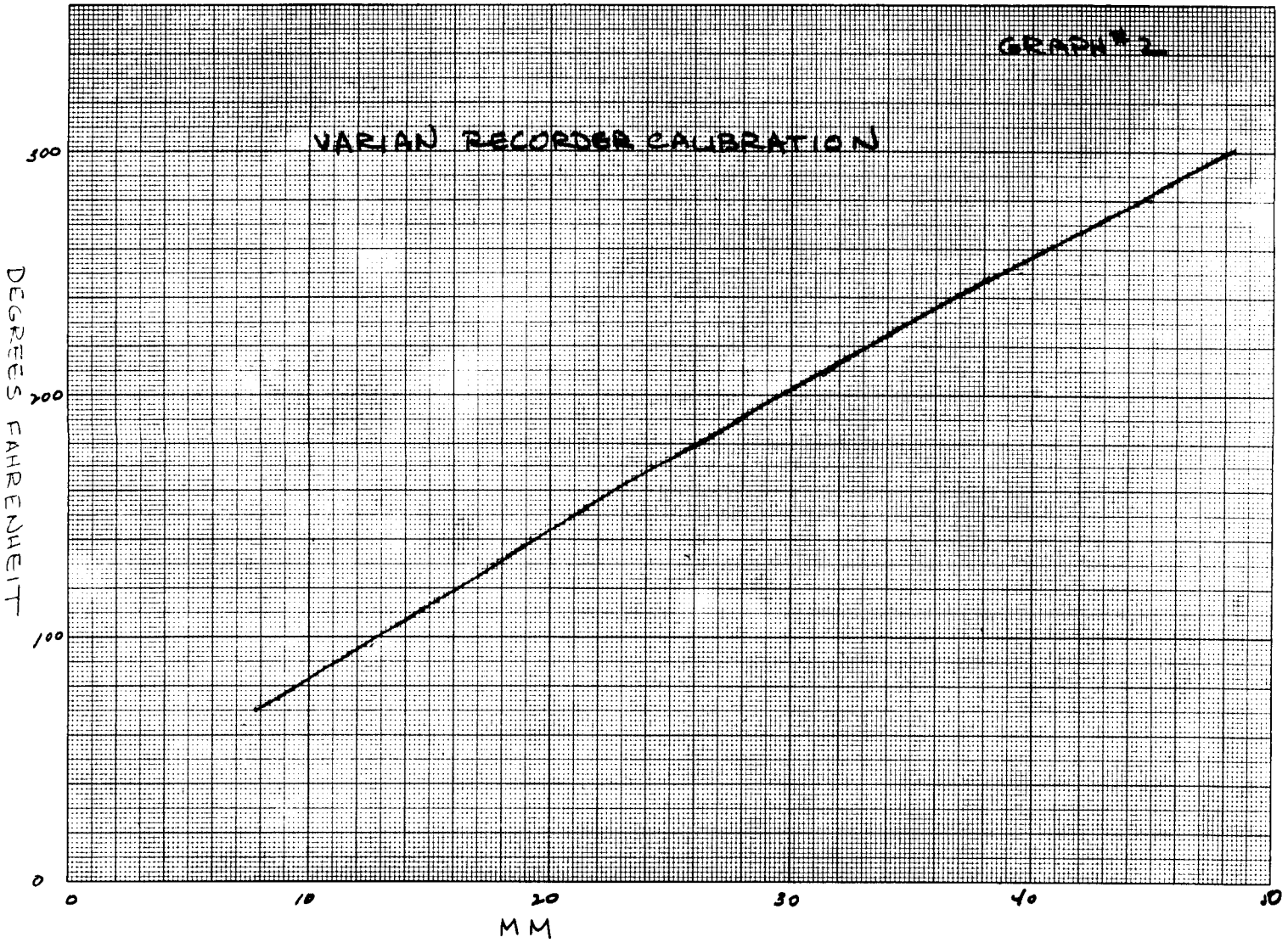


SET-UP "A"



SET-UP "B"


GRAPH I
TEST # 25
X = 1"
250
200
TEST # 24
X = 3"
150
TEST # 23
X = 6"
100
90
80
70
60
50
0
5
10
15


GRAPH # 2
VARIAN RECORDER CALIBRATION
DEGREES FAHRENHEIT
300
200
100
0
0
10
20
30
40
50
MM

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-48

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Nylon Cord Thermal Tension

Date of Test: 5 July - 11 July '62

Requested by: Carl Wagner

Performed by: J. Wall, F. Kocher

Purpose of Test: To find breaking point of nylon cord under tension load of 80# and temperatures between 360°F & 460°F.

Description of Article Tested (Photographs, if any):

Nylon Cord.
Sample on File.

Test Equipment (Photographs, if any):

10 mv Varian Recorder
4 Thermocouple Hookups
A-Frame
3 Variacs
Aluminum Foil
Turnbuckles
Tensiometer
5' Heating Tape

Test Procedure:

1. Test was set-up as in SK-1.
2. Turnbuckles were used to apply 80# tension which was measured by tensiometer.
3. Cord was heated by using heating tape with aluminum foil being used to encircle apparatus.
4. Cord was heated until it broke.

Results:

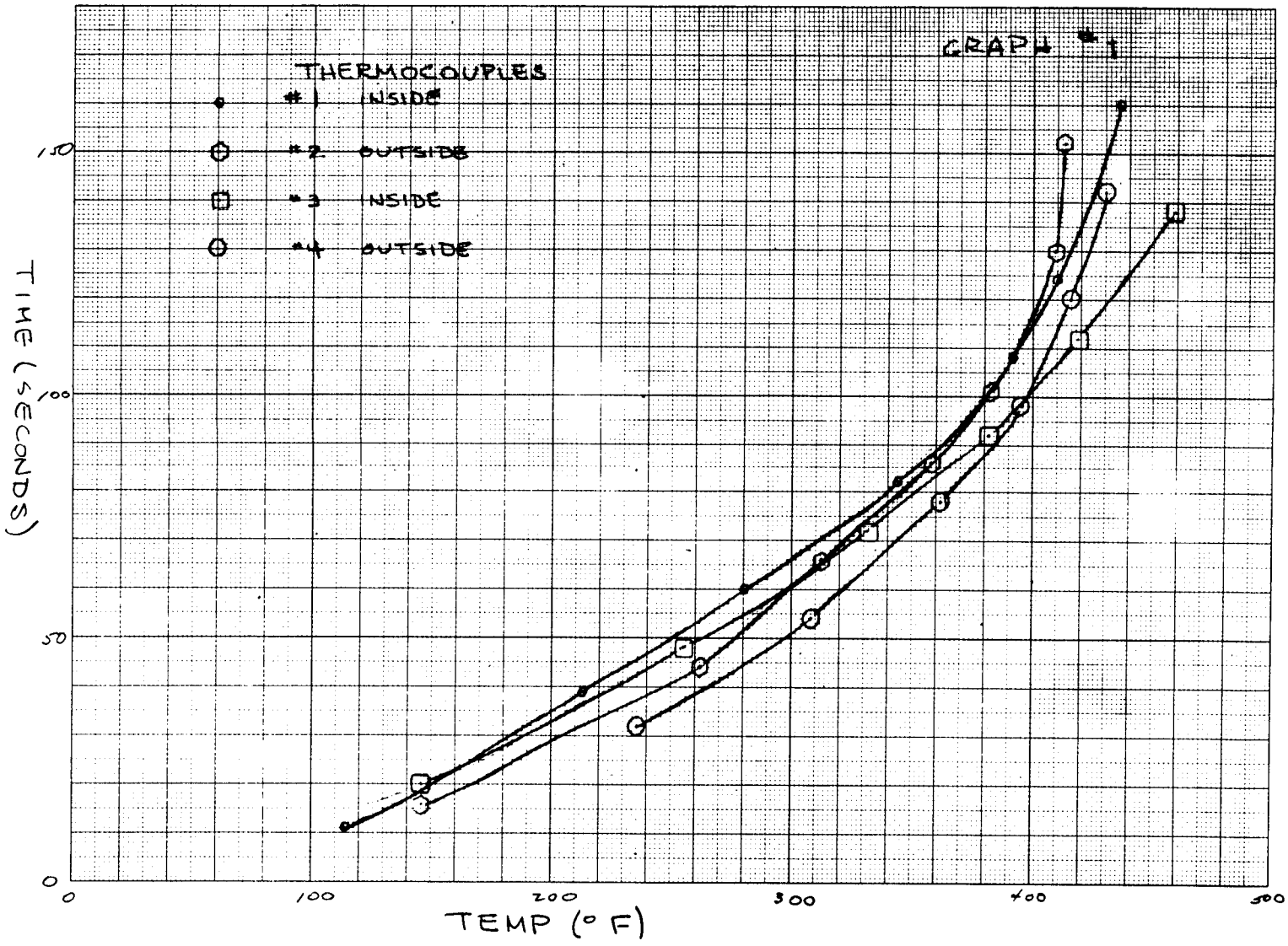
Cord separated at 2 min. 49 sec. at a temperature between 413°F & 459°F.
See Data Sheet & Graph.

Conclusions:

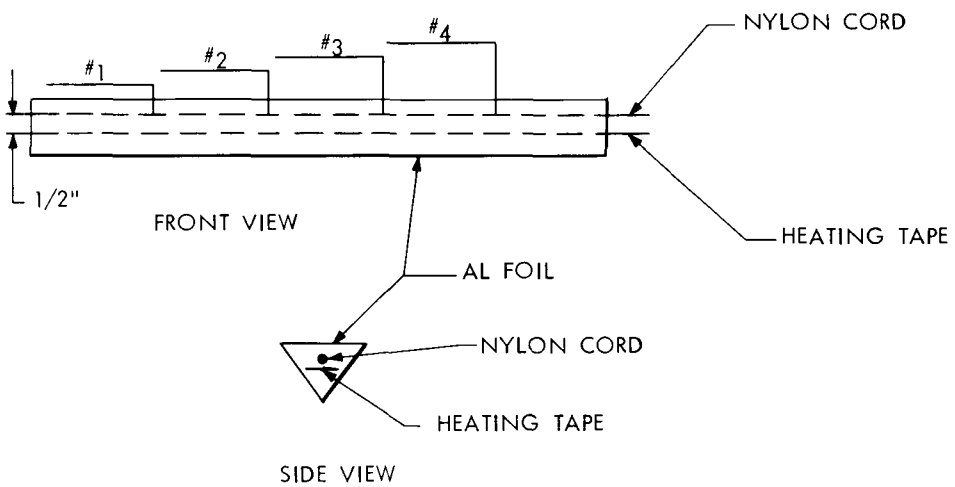
SHEET_____

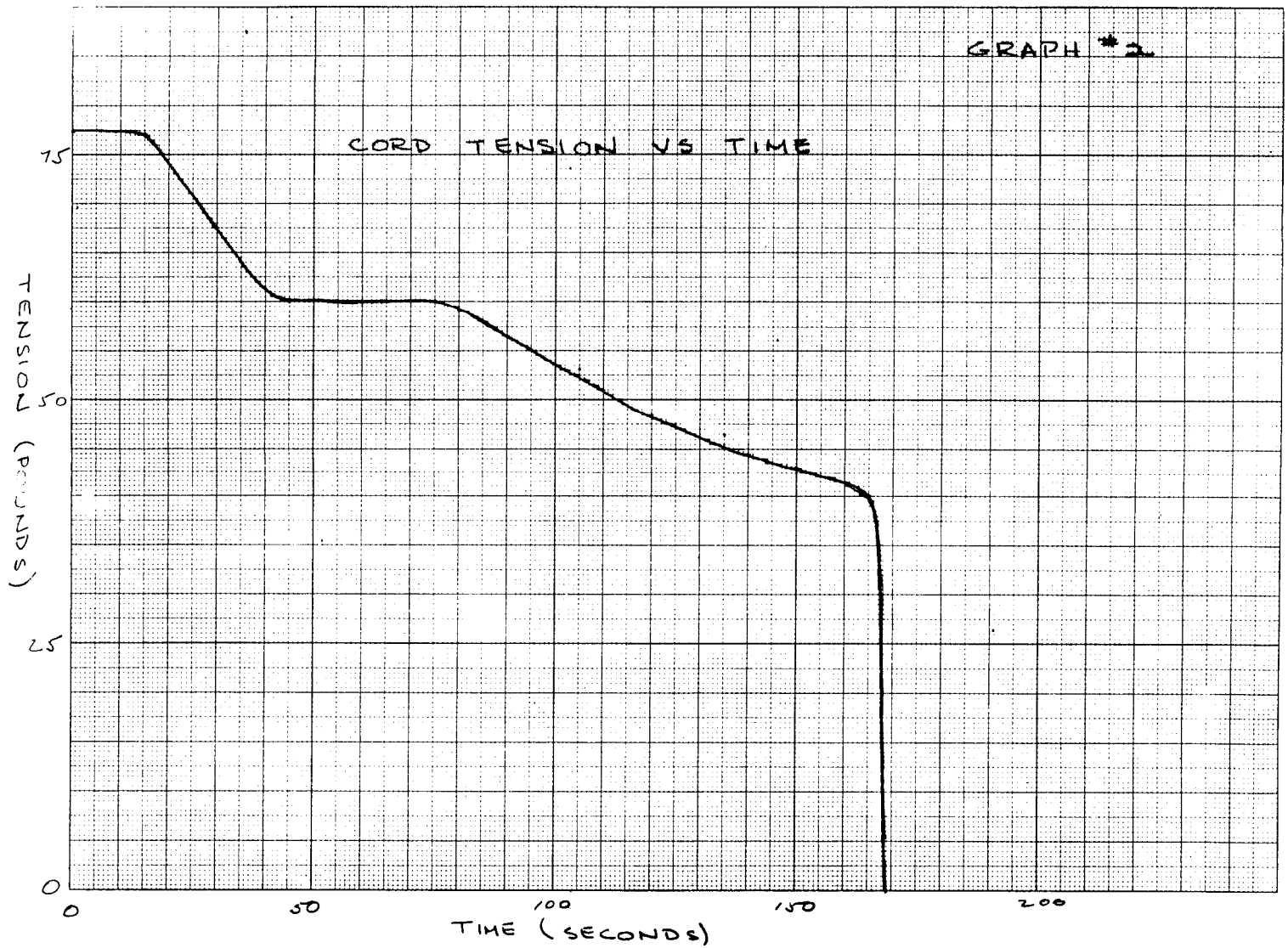
S-51 NYLON CORD THERMAL TENSION TEST

CORD TEMPERATURE							CORD TENSION			
Time	T.C.No.	Temp.					Time	Tensio-meter	Tension	
Sec.		°F					Sec.	-	#	
	No. 1									
11		114					0	31	77.5	
39		213					15	30-3/4	77	
60		280					30	26	65	
82		344					45	24	60	
108		392					60	24	60	
124		410					75	24	60	
160		436					90	22-1/2	56.5	
							105	21-1/4	53	
	No. 2						120	19-1/2	48.5	
16		146					135	18-1/2	46.5	
44		262					150	17-1/4	43	
66		312					165	16	40	
86		358					169	0	0	FAIL
101		382								
130		409								
152		413								
	No. 3									
20		146								
48		257								
72		331								
92		382								
112		419								
138		459								
	No. 4									
32		236								
54		308								
78		362								
98		395								
120		416								
142		430								
144		436								


GRAPH #1
THERMOCOUPLES
#1 INSIDE
#2 OUTSIDE
#3 INSIDE
#4 OUTSIDE
TIME (SECONDS)
TEMP (° F)
0
50
100
150
0
100
200
300
400
500

SK - 1


#1
#2
#3
#4
NYLON CORD
1/2"
FRONT VIEW
HEATING TAPE
AL FOIL
NYLON CORD
HEATING TAPE
SIDE VIEW


GRAPH #2.
CORD TENSION VS TIME
TENSION (POUNDS)
75
50
25
0
0
50
100
150
200
TIME (SECONDS)

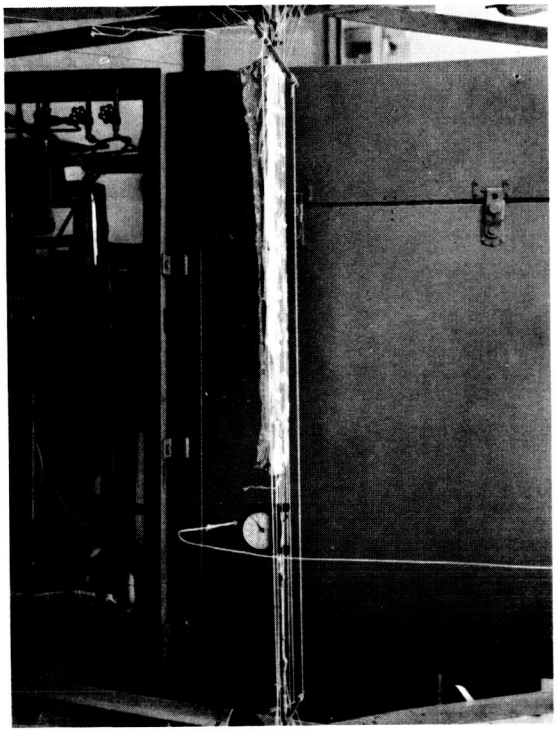


Photo No. 1—Test Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-24

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Nylon Strain Test

Date of Test: 27 Jan '62

Requested by: Carl Wagner

Performed by: D. Corbin & C. Wagner

Purpose of Test: To determine strain

Description of Article Tested (Photographs, if any):

Nylon Cord

Test Equipment (Photographs, if any):

Dillon Universal Testing Machine

Test Procedure:

Test #1

1. Cord was put on 1" diam. spools ten inches apart.
2. Load was applied at 1.200 in/min "approx."

Test #2

1. Loops were put in each end of cord. These loops were put on hooks ten inches apart. Rate of applied load was not recorded.

Results:

See Stress-Strain Curves.

Test #1

Cord sheared in clamp at approximately 130#.

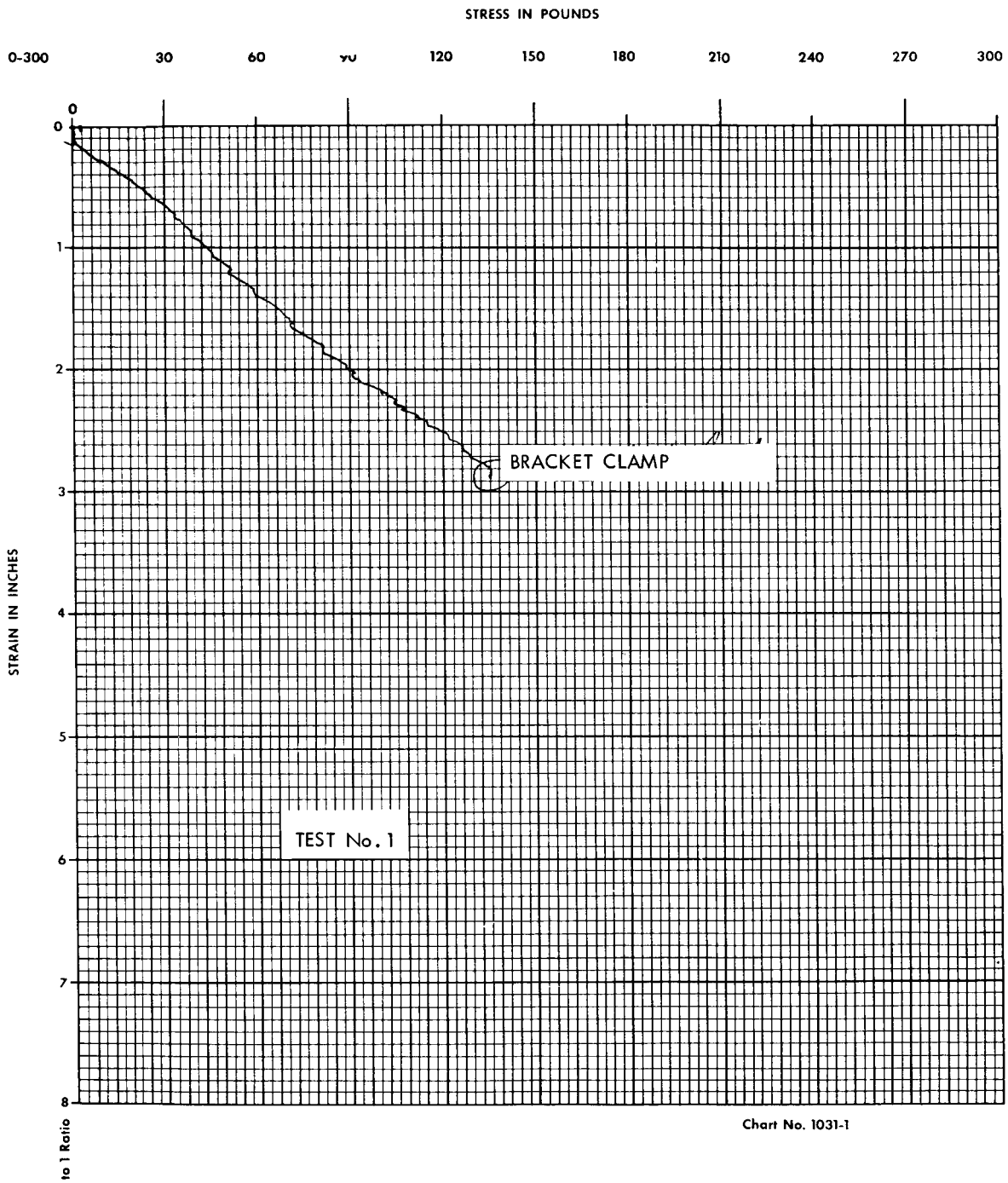
Test #2

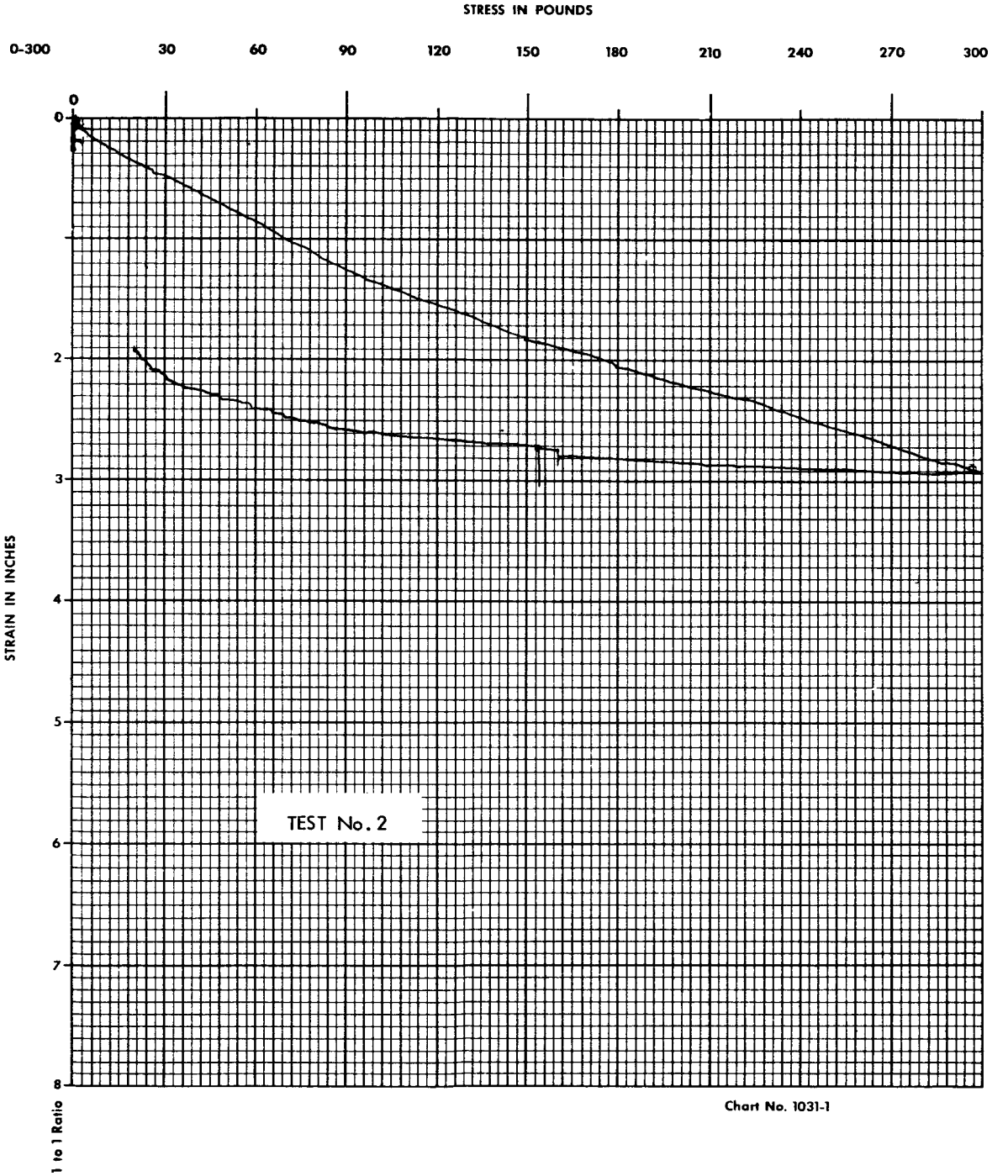
Void because hooks yielded when load was applied.

Conclusions:

More detailed testing required.

CLW


STRESS IN POUNDS
0-300
30
60
90
120
150
180
210
240
270
300
0
0
1
2
3
4
5
6
7
8
STRAIN IN INCHES
BRACKET CLAMP
TEST No. 1
Chart No. 1031-1
1 to 1 Ratio


STRESS IN POUNDS
0-300
30
60
90
120
150
180
210
240
270
300
0
STRAIN IN INCHES
0
2
3
4
5
6
7
8
TEST No. 2
Chart No. 1031-1
1 to 1 Ratio

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-39

FWK	P.E.
CLW	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Tie-Down Cord High-Temp Strength Comparison (S-51 vs. S-3).

Date of Test: 25 May '62

Requested by: F.W. Kosmerl

Performed by: Kauffman, Sween, Wagner, Kosmerl, Baumann

Purpose of Test: To determine if pluming of X-248 rocket motor had deteriorated boom & paddle tie-down cord to breaking point prior to desired release time.

Description of Article Tested (Photographs, if any):

Sample cords of each satellite (S-51 & S-3), two feet long.
NOTE: S-3 cord was dirty (light tan color, black nylon thread woven in pattern).

Test Equipment (Photographs, if any):

2-60# weights
Electric Hot Plate
Double Pulley
Sheet double thickness aluminum foil

Test Procedure:

1. Cords were set-up as shown in SK-1.
2. Heat was applied until both samples broke and cord was visually inspected intermittently.

Results:

See Data Sheet

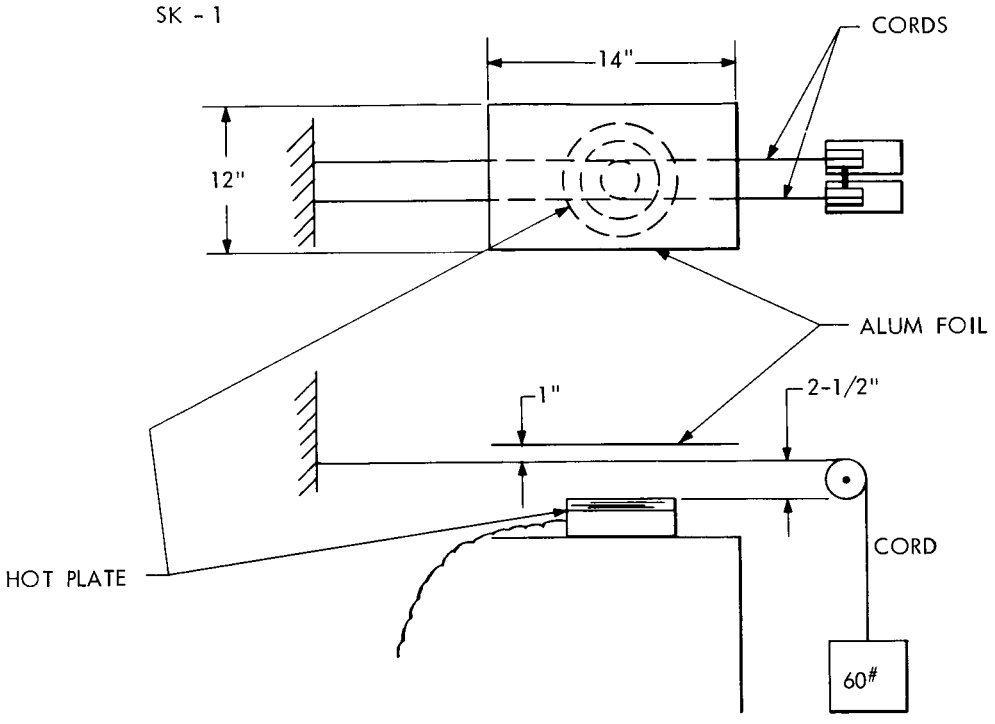
Conclusions:

S-51 cord withstood the heat-load condition 2.4 times longer than the S-3 cord.

On Flight Units:
S-3 cords were released 1200 seconds after spin-up.
S-51 cords were released 960 seconds after spin-up.

S-3 Flight cords functioned properly in flight.
S-51 Flight unit should do likewise since its temp-load time was shorter by 240 seconds.

A consideration: The heat transfer is directly proportional to the fluid density & although high in earth atmosphere (as in this test) could be near zero in near-orbit conditions (close to vacuum); i.e., heat due to convection in flight is nil - only radiant heat.



ROOM TEMPERATURE 68°F

HOT PLATE TEMPERATURE 950 - 1000°F

SHEET_____

Heat Time (min.)	Temp.* (°F)	Cord S-3	Status S-51							
1:00	170	OK	OK							
1:30	200	OK	OK							
2:00	260	OK	OK							
2:12	280	OK	OK							
2:15	290	OK	OK							
2:30	320	OK	OK							
2:45	340	OK	OK							
3:00	350	OK	OK							
3:15	370	OK	OK							
4:00	400	OK	OK							
4:06	400	BROKE	OK							
6:10	400	-	OK							
7:10	400	-	OK							
7:35	400	-	OK							
9:00	400	-	OK							
9:10	410	-	OK							
9:30	420	-	OK							
9:55	440	-	BROKE							

*AT CORD HEIGHT

DATA PAPER (11 COLUMN) PRNC-GEN-66 (Rev. 9-53) NAVY-BUPO PRNT. WASH., D.C.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-29

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Qualification of Nylon Cord Release

Date of Test: 20 Feb. '62

Requested by: Carl Wagner

Performed by: J. H. Kauffman

Purpose of Test: To qualify release mechanism with nylon cord.

Description of Article Tested (Photographs, if any):

Nylon Cord DS-51-103-4
Holex Pin Puller No. 2792

Test Equipment (Photographs, if any):

Simpson Low Range Resistance Tester
F&M Weights
Weight Pan
S-51 Power Supply (batteries)
See Photo #1
See SK-1

Test Procedure:

1. Mount Holex pin puller on 1/4" alum. plate.
2. Mount pulleys for nylon cord.
3. Check resistance of 2 squibs before & after test.
4. Check power supply before & after test.
5. Hook nylon cords to pin puller shaft, over pulley & hang 60# on each nylon cord.
6. Hook up squib to power supply via switch & fire.

NOTE: Test performed in ambient conditions.

Results:

A-OK!

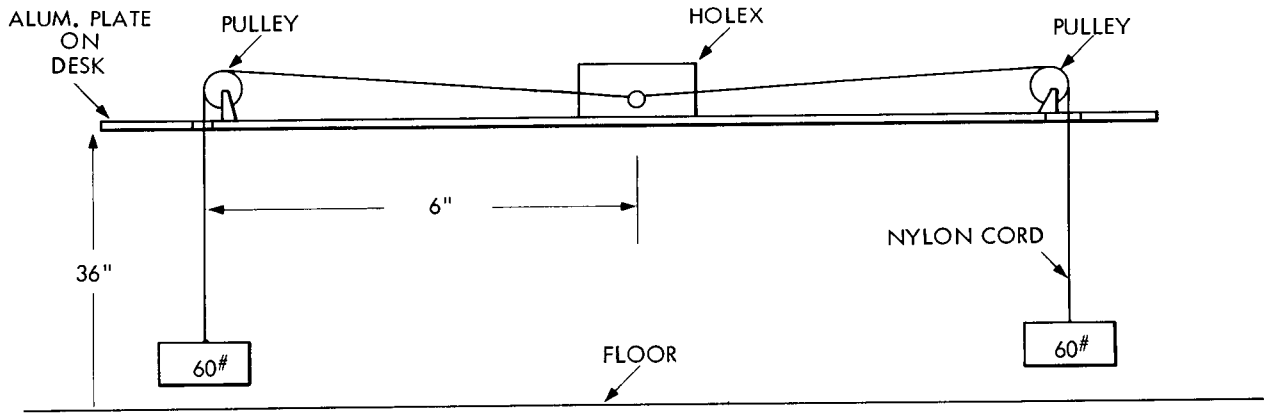
Before Test	After Test	
Squibs A&B = 1.36 Ω	A&B = ∞	FIRED.
" C&D = 1.31 Ω	C&D = ∞	
A,D&B,C = 0.66 Ω	A,D&B,C = ∞	
Battery Voltage = 14VDC	Battery Voltage = 14VDC	

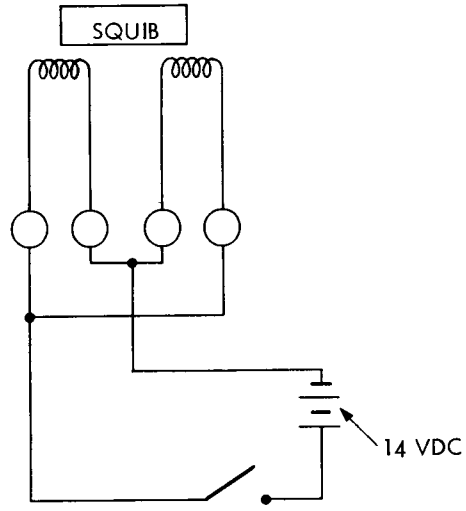
JHK

Conclusions:

Nylon cord will correctly be released by pin pullers and allow booms & paddles to extend.

CLW


ALUM. PLATE
ON
DESK
PULLEY
HOLEX
PULLEY
6"
36"
NYLON CORD
60#
FLOOR
60#


SQUIB
14 VDC

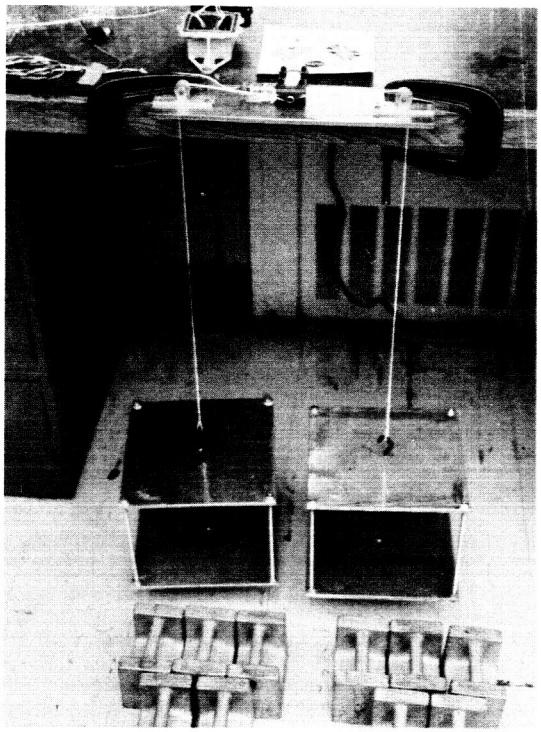


Photo No. 1—Test Equipment Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-47

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Release Tension Test

Date of Test: 16 July '62

Requested by: Carl Wagner

Performed by: A. Pierro, D. Bower

Purpose of Test: To measure cord tension at which pull down springs pull cord from saddles.

Description of Article Tested (Photographs, if any):

Nylon cord release mechanism on S-51 vibration fixture, with two paddles and one each inertia and sensor boom.

Test Equipment (Photographs, if any):

Spring Scales
Release Springs

Test Procedure:

1. With simulated conditions for sensor boom on third stage motor, a force of 12.5# was exerted on the boom, while a force was applied to the nylon cord. The initial force was 50# and it varied down to zero.
2. Simulated conditions for paddles and inertia boom on third stage motor. A force of 19.2# was exerted on paddle #2, 17.5# on paddle #3, and 11.5# on inertia boom, while tension on cord varied from zero to fifty pounds.

Results:

1. Less than four pounds of tension on nylon cord before spring pulls cord away from boom.
2. Between four and six pounds tension on nylon cord before spring pulls cord away from paddles and boom.

Conclusions:

Since booms and paddles exert centrifugal forces the string tension cannot decrease to below 15# at 180 rpm - not enough to allow cord to slip off booms and/or paddles.

VI – ANTENNA

File No. 500-13-2

RT	P.E.
CLW	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Antenna Material Test

Date of Test: 21 Aug 1961

Requested by: R. Treadwell

Performed by: Sween, Flatley, Kauffman

Purpose of Test: To determine temper condition of antenna

Description of Article Tested (Photographs, if any):

Aluminum Rod
O.D. = 5/16" ±1/64"
I.D. = 17/64"
Aged for 20 hours at 320°F in Blue "M" oven.

Test Equipment (Photographs, if any):

See Photo #1
See SK-1
2 V-Blocks & Clamps
Federal Dial Indicator (.001) 1" travel
Weight Pan & Weights

Test Procedure:

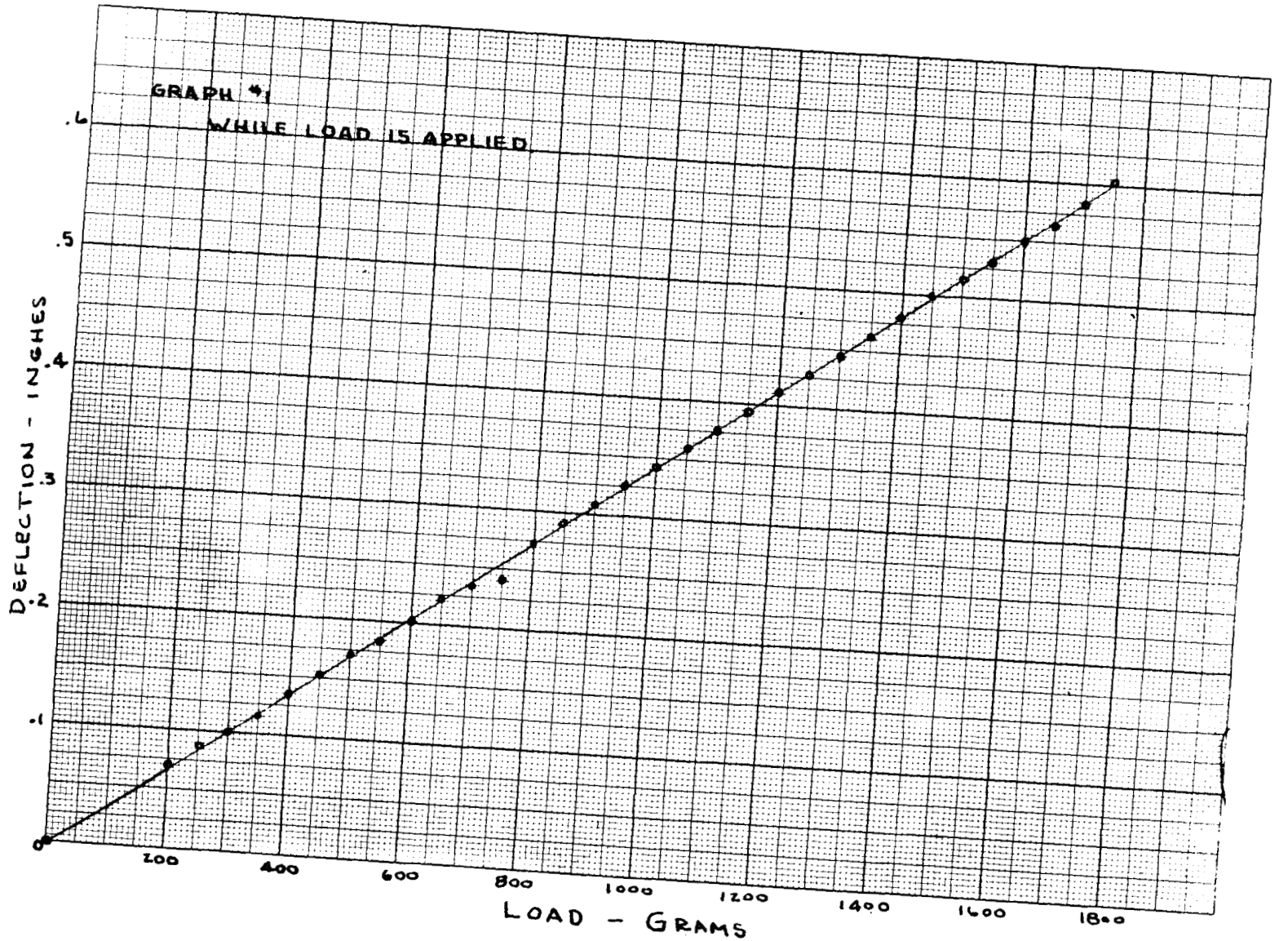
1. Attach aluminum rod to V-blocks & clamp to surface plate.
2. Set up dial indicator 10" from fixed end of rod.
3. Apply load in 50 g increments, 10" from fixed end of rod, starting at 200 g with a maximum load of 1750 g.
4. Record:
   A. Load
   B. Deflection
   C. Set. = Deflection of rod after load is applied & then removed.

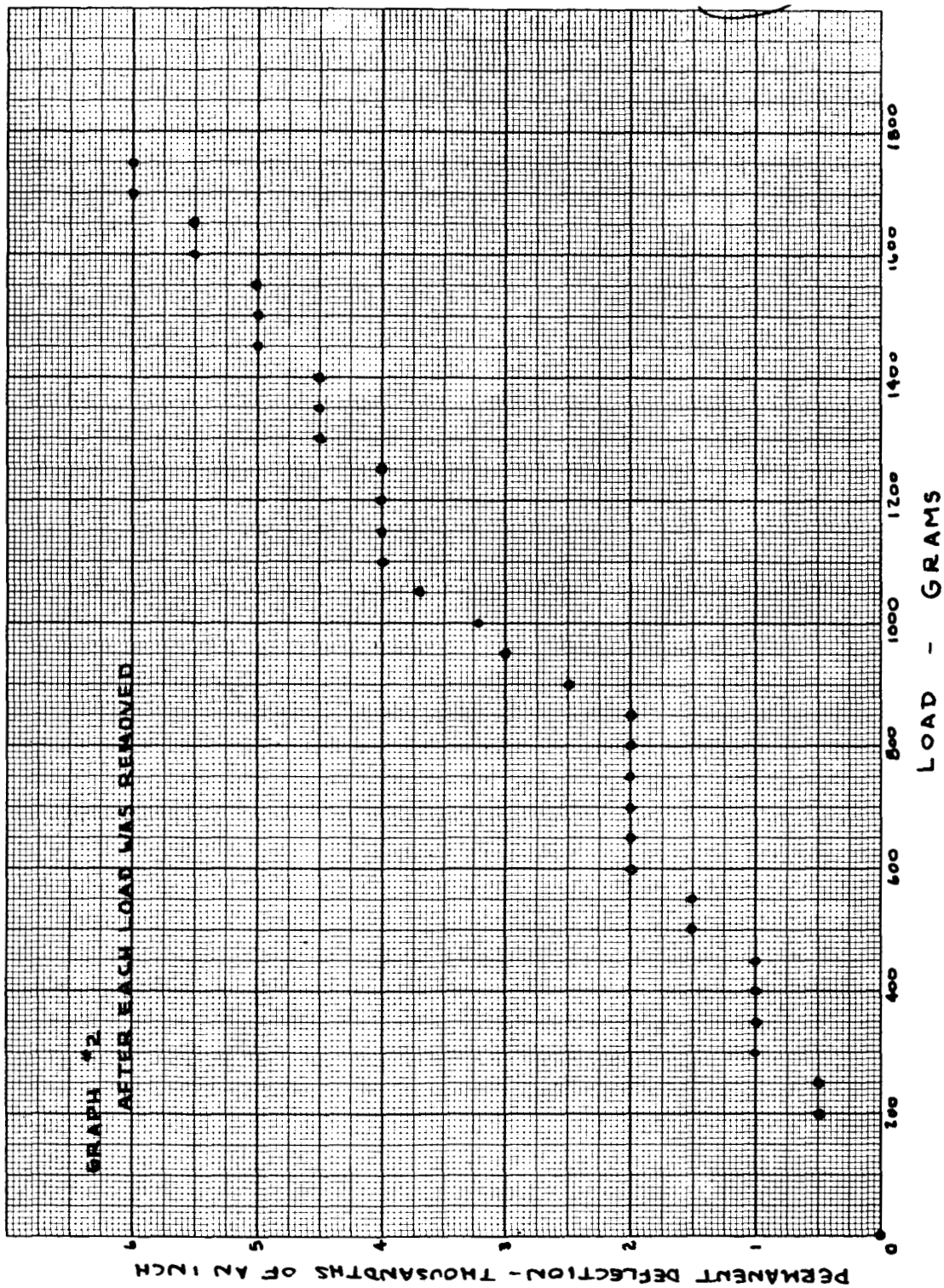
Results:

Rod withstood a total of 1750 g without failure and the set was .006" after this load.
Graphs:
Data Sheet

Conclusions:

Test results indicate specimen is 6061 AL.AL., heat treated to -T6 temper.


GRAPH #1
WHILE LOAD IS APPLIED
DEFLECTION - INCHES
.6
.5
.4
.3
.2
.1
0
200
400
600
800
1000
1200
1400
1600
1800
LOAD - GRAMS


GRAPH #2
AFTER EACH LOAD WAS REMOVED
PERMANENT DEFLECTION - THOUSANDTHS OF AN INCH
LOAD - GRAMS
0
1
2
3
4
5
6
200
400
600
800
1000
1200
1400
1600
1800

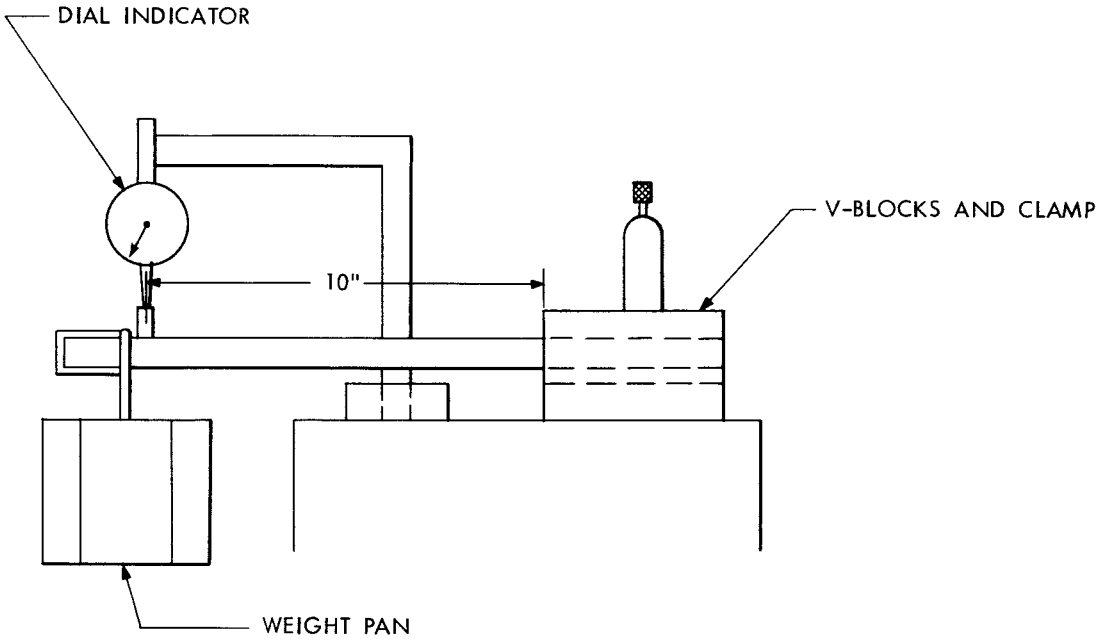
SHEET _____

S-51 ANTENNA MATERIAL 21 Aug. 1961

320°F - 20 hrs 10" Moment Arm

Grams Load	Inches Deflect	No Load Deflect								
0	0	0								
200	.070	.0005								
250	.0885	.0005								
300	.101	.001								
350	.117	.001								
400	.135	.001								
450	.1515	.001								
500	.172	.0015								
550	.185	.0015								
600	.202	.002								
650	.2225	.002								
700	.236	.002								
750	.241	.002								
800	.274	.002								
850	.2915	.002								
900	.3085	.0025								
950	.325	.003								
1000	.3425	.0032								
1050	.360	.0037								
1100	.377	.004								
1150	.394	.004								
1200	.4115	.004								
1250	.4285	.004								
1300	.445	.0045								
1350	.463	.0045								
1400	.480	.0045								
1450	.4995	.005								
1500	.516	.005								
1550	.532	.005	← 25,000 psi							
1600	.549	.0055								
1650	.564	.0055								
1700	.5845	.006								
1750	.6025	.006								

SK - 1 SKETCH



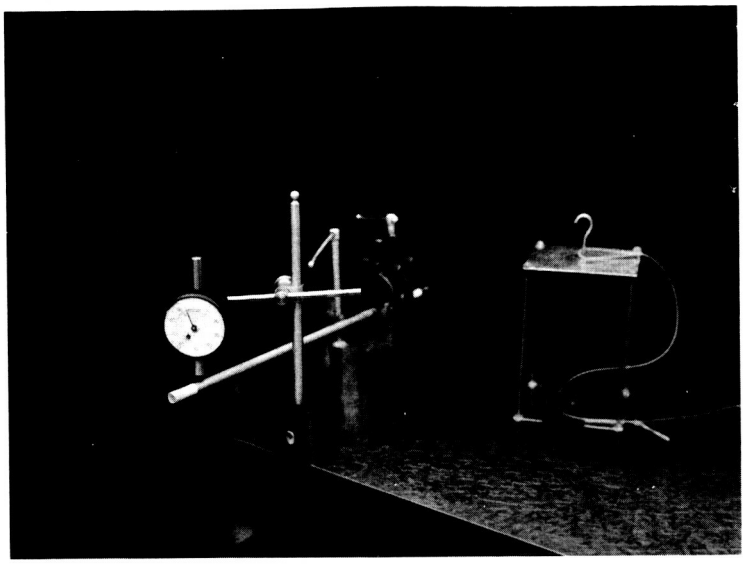


Photo No. 1—Test Equipment and Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-14

RT	P.E.
CLW	S.H.
RCB	B.H.

Name of Test: Antenna Temper

Date of Test: 23 & 24 Aug. '61

Requested by: R. Treadwell

Performed by: John Sween & W. Flatley

Purpose of Test: To check T-6 Temper of Antennas.

Description of Article Tested (Photographs, if any):

Telescoping Aluminum Antenna
DWG. DS 51-13

Test Equipment (Photographs, if any):

Weight Pan
Ohaus Weights
2 Height Gages.
Photo #1 – Test Equipment Set-up.

Test Procedure:

Test was set up exactly as per sketch (DWG. DS-51-13).

1. Reference height readings were taken with no load.
2. Weights were added in 50g increments from 400g to 650g, with a final load of 675g.
3. As each load was applied, deflection was measured. Load was removed and a no load reading was taken.

NOTE: Because the weights caused the joints of the antenna to show a deflection at the no load position, the joints were pulled apart and snapped into position by hand. No load readings were then taken.

Results:

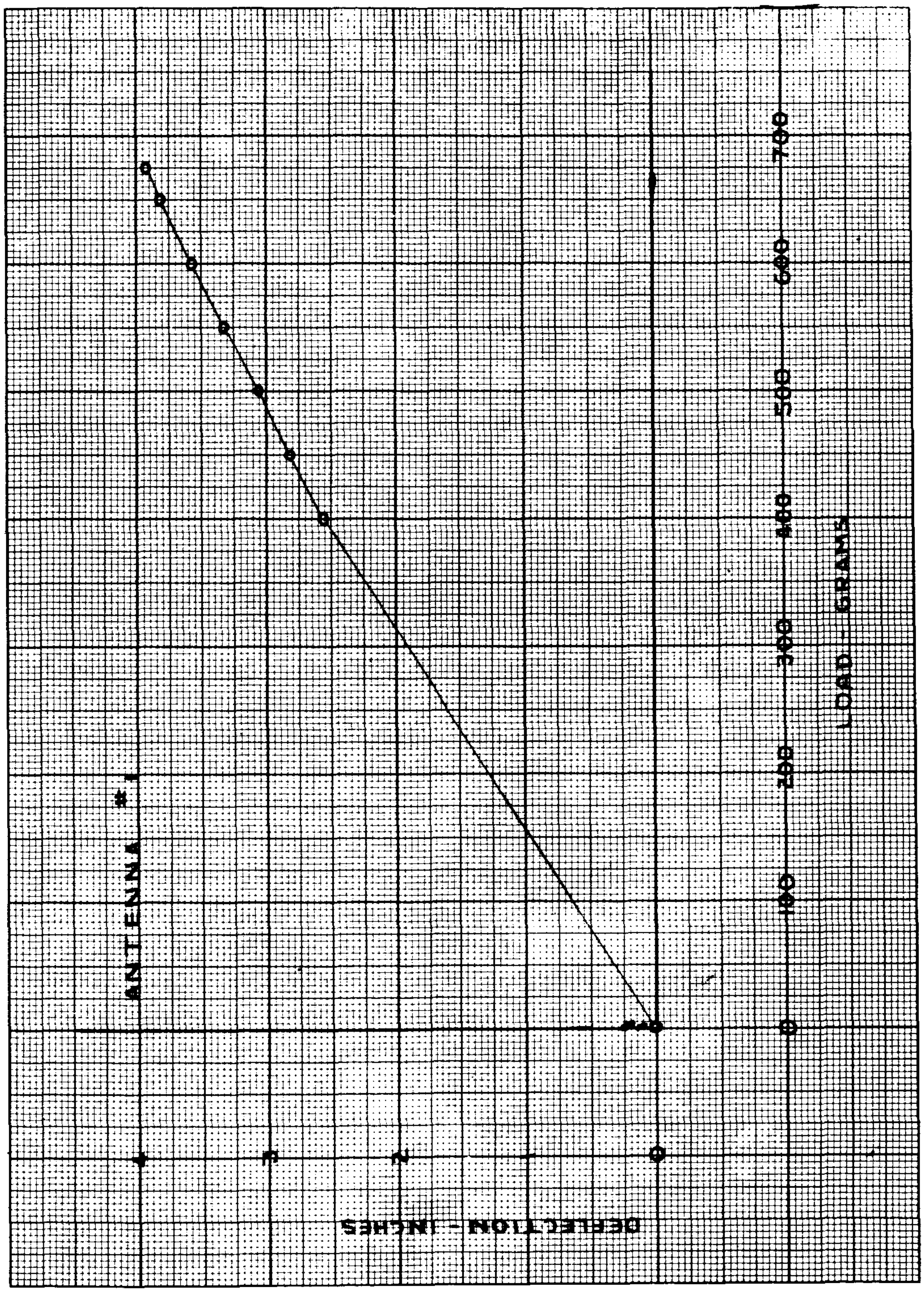
4 Graphs
1 Data Sheet
1 Photograph - Photo #2 Test Procedure.

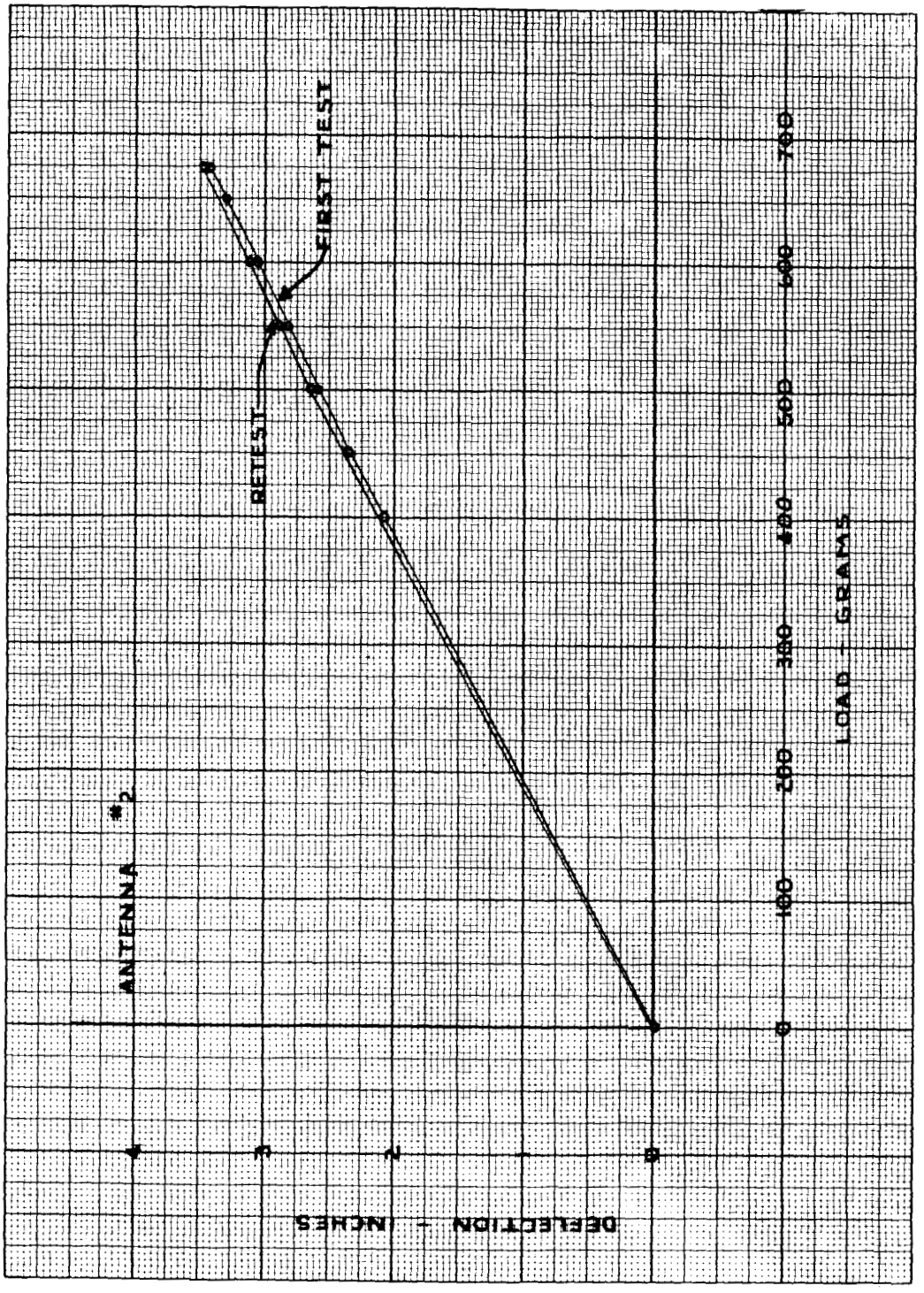
Conclusions:

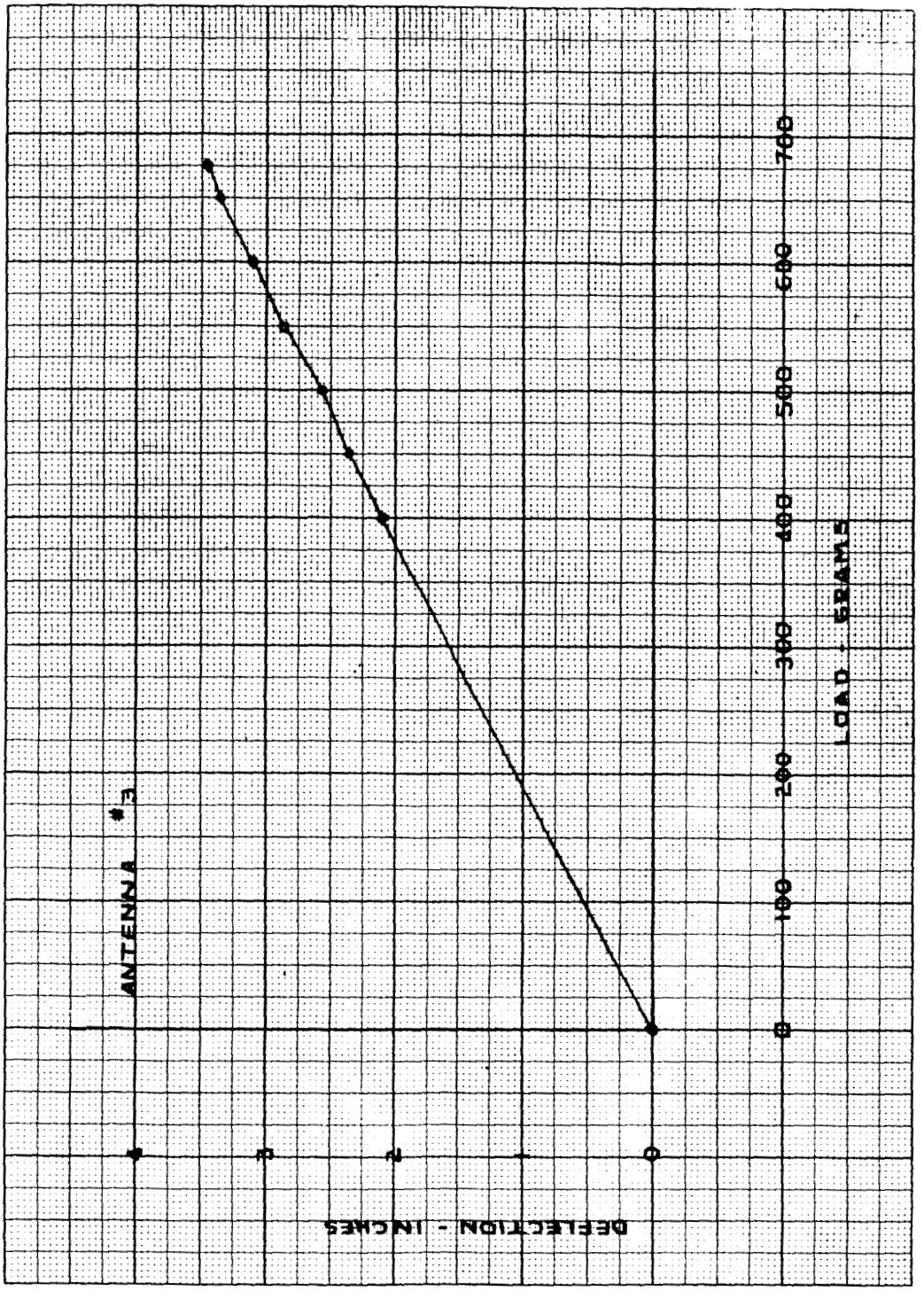
Four antennas tested are acceptable and assumed to be in the T-6 temper. Permanent set recorded with antenna #2 is assumed to be not a permanent set, but a result of play or slippage in the joints, as a small load in the opposite direction produced a "no-set" reading or "return to original position."

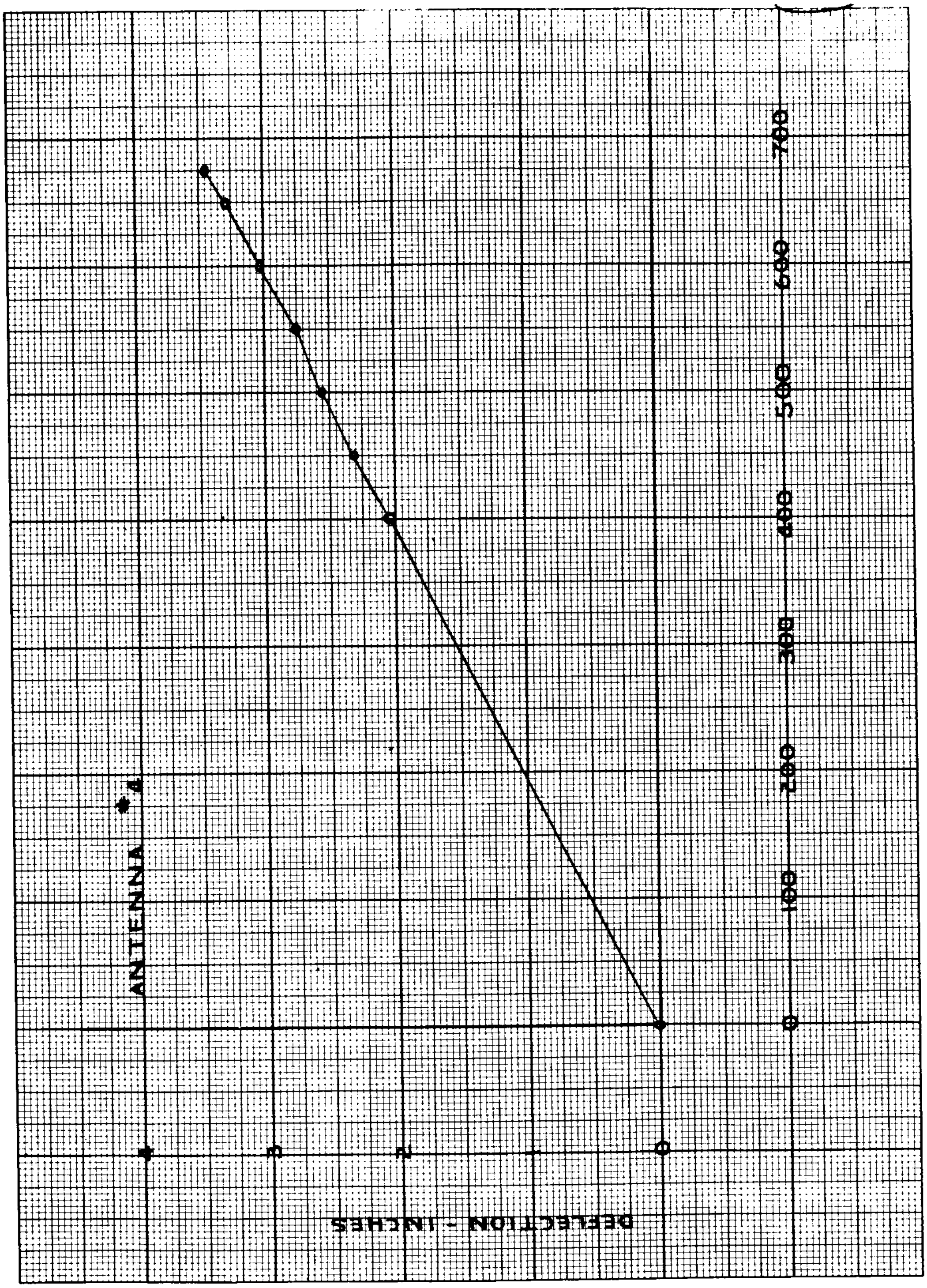
SHEET_____

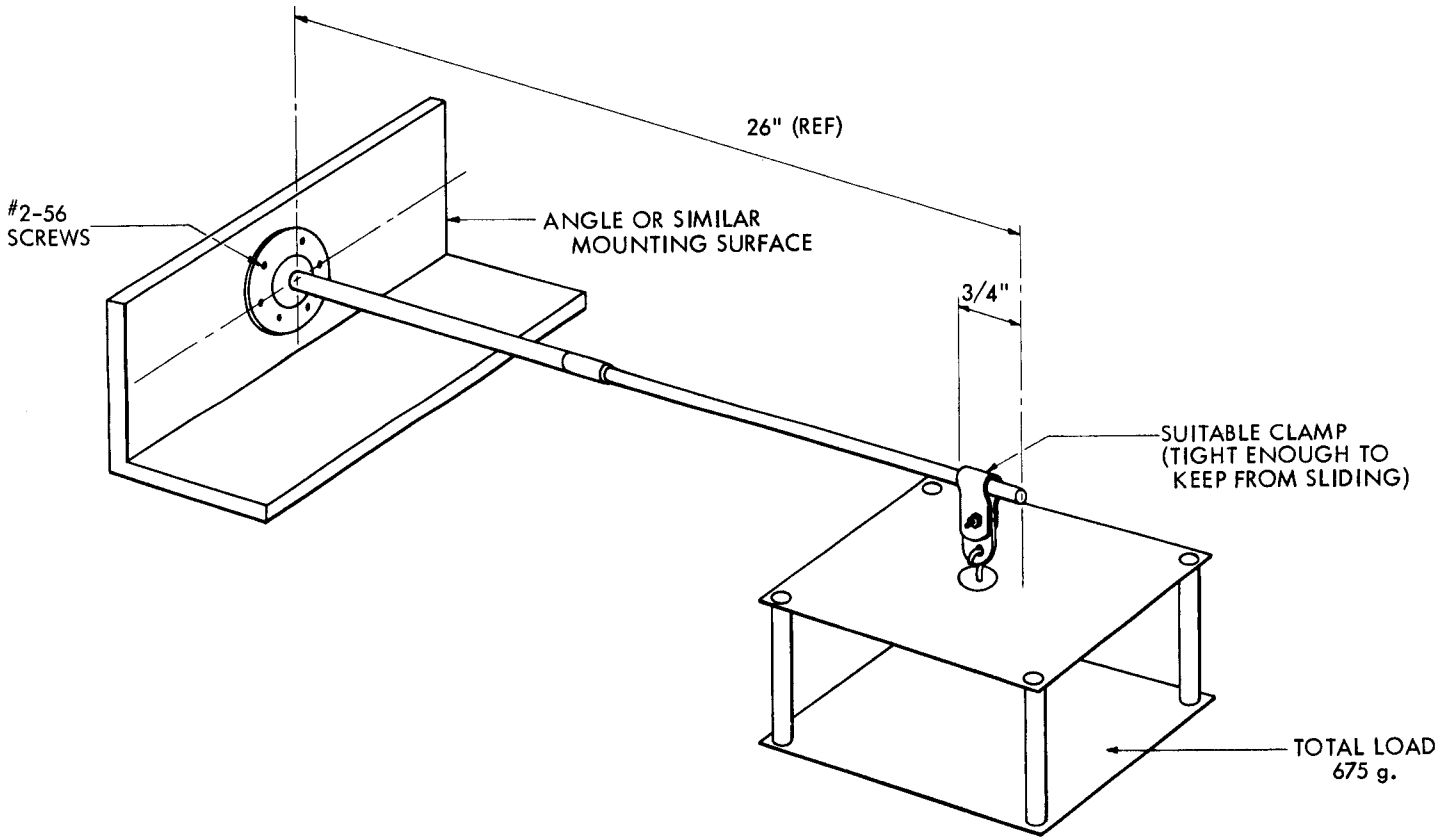
Antenna No.	Grams Load	Inches Total Deflection	Inches Change	Inches Total Set		Grams Load	Inches Total Deflection	Inches Change	Inches Total Set	
	0	0.000	0.000	0.000						
	400	2.564	2.564	0.000						
	450	2.837	0.273	0.000						
	500	3.051	0.214	0.000						
No. 1-13-1	550	3.330	0.279	0.000						
	600	3.531	0.201	0.000						
	650	3.798	0.267	0.000						
	675	3.897	0.099	0.000						
	0	0.000	0.000	0.000						
	400	2.057	2.057	0.000		0	0.000	0.000	0.000	
	450	2.307	0.250	0.000		500	2.614	2.614	0.016	
	500	2.553	0.246	0.000		550	2.851	0.237	0.016	
No. 1-13-2	550	2.798	0.245	0.000		600	3.103	0.252	0.027	No. 1-13-2 RETEST
	600	3.059	0.261	0.006		675	3.473	0.370	0.034	
	650	3.307	0.248	0.034						
	675	3.431	0.124	0.034						
	0	0.000	0.000	0.000						
	400	2.086	2.086	0.000						
	450	2.332	0.246	0.000						
	500	2.566	0.234	0.000						
No. 1-13-3	550	2.894	0.328	0.000						
	600	3.080	0.186	0.000						
	650	3.346	0.266	0.000						
	675	3.450	0.104	0.000						
	0	0.000	0.000	0.000						
	400	2.038	2.038	0.000						
	450	2.296	0.258	0.000						
	500	2.534	0.238	0.000						
No. 1-13-4	550	2.783	0.249	0.000						
	600	3.025	0.242	0.000						
	650	3.270	0.245	0.004						
	675	3.396	0.126	0.007						


ANTENNA # 1
LOAD - GRAMS
0
100
200
300
400
500
600
700
DEFLECTION - INCHES
0
1
2
3
4


ANTENNA #2
DEFLECTION - INCHES
LOAD - GRAMS
0
100
200
300
400
500
600
700
1
2
3
4
FIRST TEST
RETEST


ANTENNA #3
LOAD - GRAMS
0
100
200
300
400
500
600
700
DEFLECTION - INCHES
0
1
2
3
4


ANTENNA #4
DEFLECTION - INCHES
0
100
200
300
400
500
600
700
0
1
2
3
4


26" (REF)
#2-56
SCREWS
ANGLE OR SIMILAR
MOUNTING SURFACE
3/4"
SUITABLE CLAMP
(TIGHT ENOUGH TO
KEEP FROM SLIDING)
TOTAL LOAD
675 g.

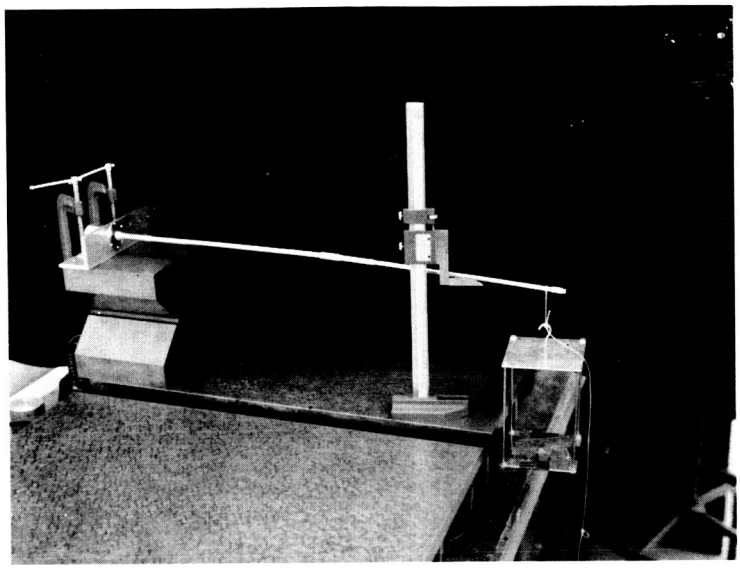


Photo No. 1—Test Equipment Set-Up

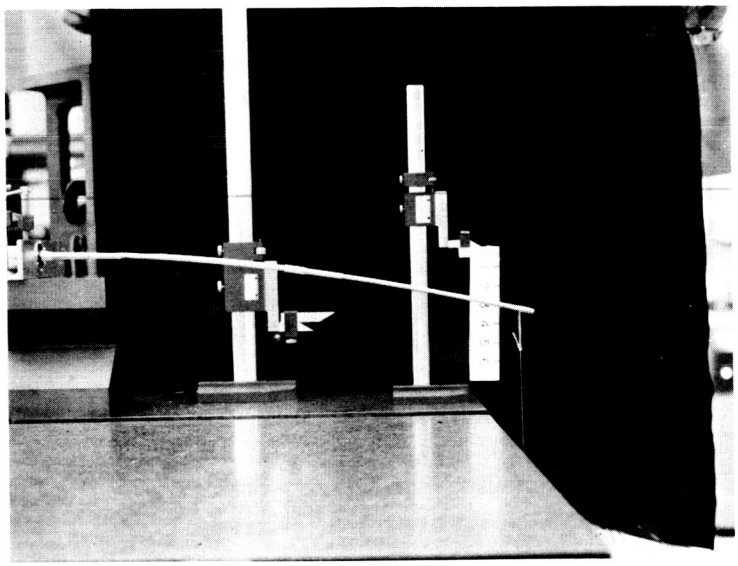


Photo No. 2—Test Procedure

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-13-1

RT	P.E.
CLW	S.H.
RCB	B.H.

Name of Test: Tubing Temper Determination

Date of Test: 17 Aug. '61

Requested by: Treadwell

Performed by: J. Kauffman & J. Sween

Purpose of Test: Find Temper of Tubing

Description of Article Tested (Photographs, if any):

1 Pc. AL AL Tubing 5/16" O.D., approx. 30" long.
1 Pc. AL AL Tubing 1/4" O.D., approx. 30" long.

Test Equipment (Photographs, if any):

V-Blocks & Clamps
Height Gauge
Weight Pan
Ohaus Gram Weights
Surface Plate
Blue "M" Oven

Test Procedure:

1. Specimens were aged in oven at 350°F for five hours to bring total age time to 9 hours at 350°F.
2. After specimens were aged, they were set-up on surface plate as per photographs.
3. Load was applied in 50g increments & both load & no-load readings were recorded at each increment.
4. Load was applied 15" from cantilever.

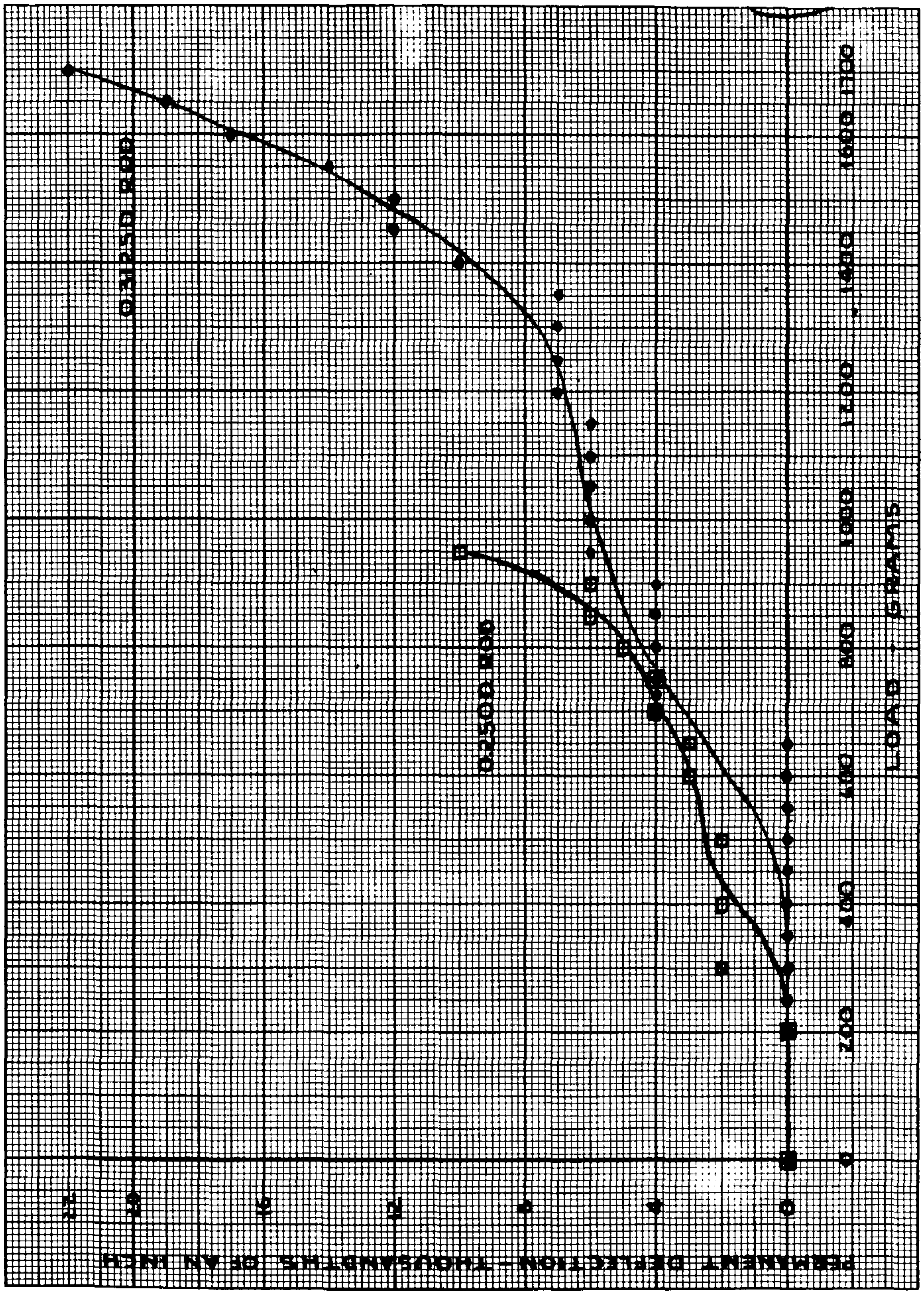
See Photo #1, Set-Up.
See Photo #2, Procedure.

Results:

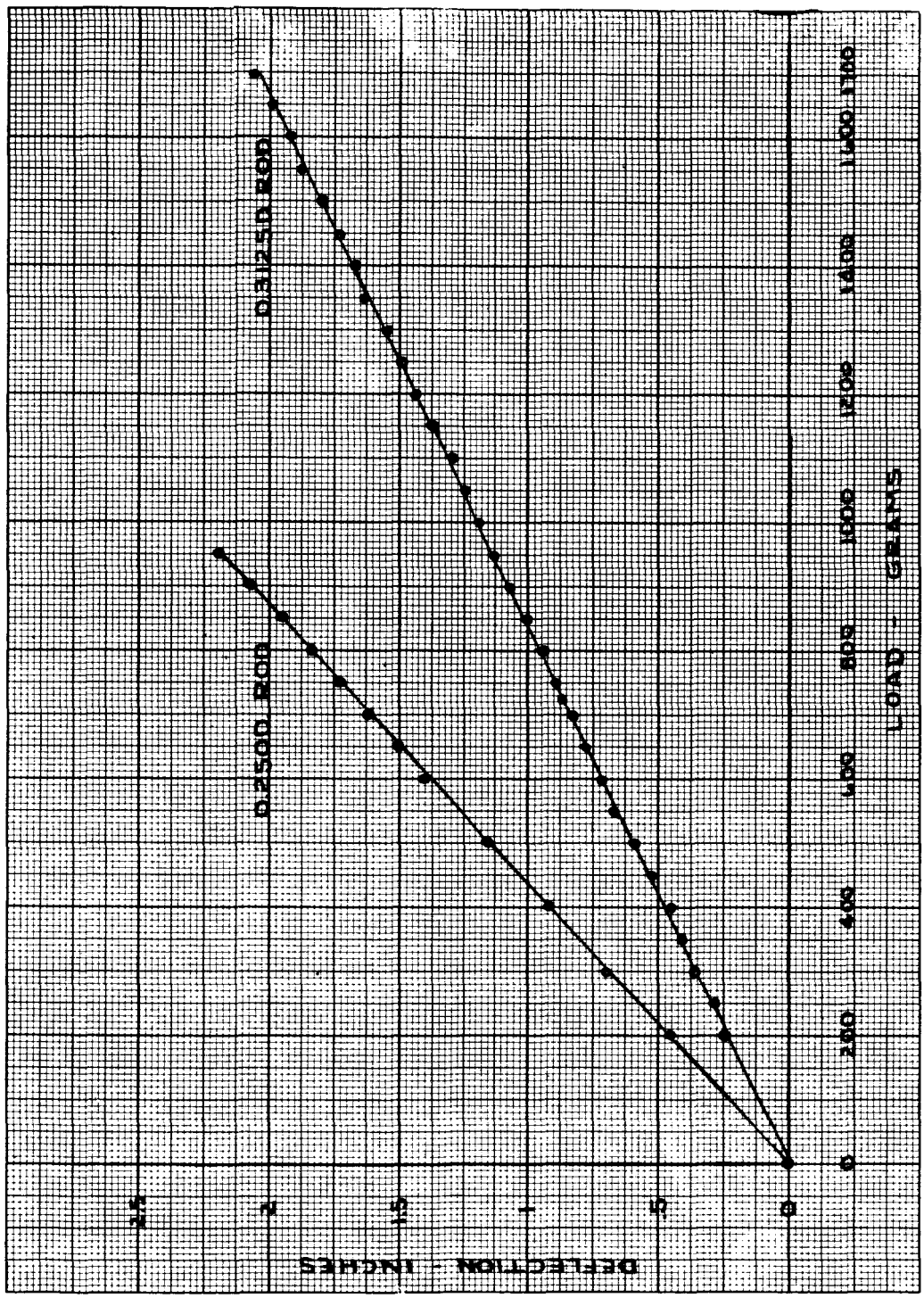
See Data Sheet
See Graphs

Conclusions:

Test results indicate specimens are 6061 AL. AL. tubing, -T6 temper.



0.3125D ROD
0.250D ROD
LOAD - GRAMS
PERMANENT DEFLECTION - THOUSANDTHS OF AN INCH


0.3125D ROD
0.2500 ROD
LOAD - GRAMS
0
200
400
600
800
1000
1200
1400
1600
1800
DEFLECTION - INCHES
.25
.2
.15
.1
.05
0

SHEET_____

S-51 ANTENNA MAT'L — ACCURACY ±.010 — 17 Aug. 61

5/16"D ROD					1/4"D ROD					
Grams Load	Inches Deflect.	In. Zero Load Deflect.			Grams Load	Inches Deflect.	In. Zero Load Deflect.			
0	0	0			0	0	0			
200	0.248	0			200	0.460	0			
250	0.278	0			300	0.700	.002			
300	0.368	0			400	0.920	.002			
350	0.408	0			500	1.150	.002			
400	0.448	0			600	1.380	.003	←	25,000 psi	
450	0.523	0			650	1.500	.003			
500	0.588	0			700	1.620	.004			
550	0.668	0			750	1.730	.004			
600	0.718	0			800	1.840	.005			
650	0.778	0			850	1.950	.006			
700	0.828	.004			900	2.070	.006			
725	0.868	.004			950	2.190	.010			
750	0.888	.004								
800	0.948	.004								
850	1.008	.004								
900	1.068	.004								
950	1.128	.006								
1000	1.188	.006								
1050	1.248	.006	← 25,000 psi							
1100	1.300	.006								
1150	1.370	.006								
1200	1.440	.007								
1250	1.490	.007								
1300	1.550	.007								
1350	1.630	.007								
1400	1.670	.010								
1450	1.730	.012								
1500	1.800	.012								
1550	1.870	.014								
1600	1.920	.017								
1650	1.990	.019								
1700	2.070	.022								

DATA PAPER (11 COLUMN) [illegible]

NAVY-BPPO PRNC, WASH., D.C.

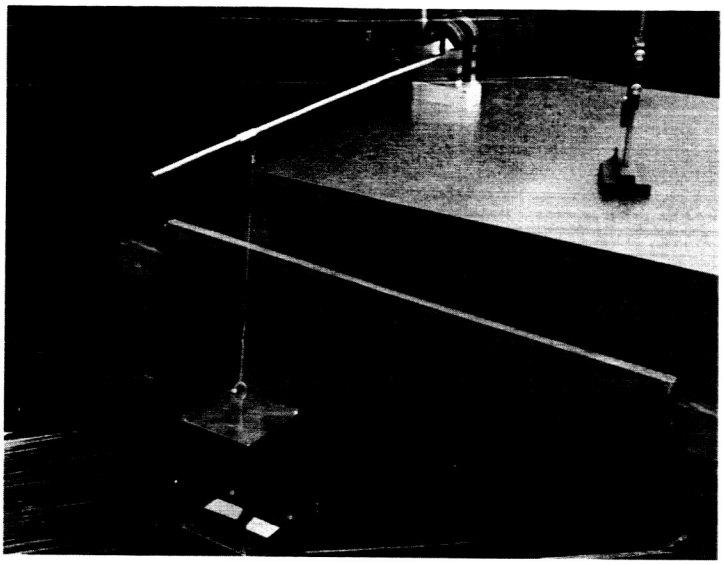


Photo No. 1–Set-Up

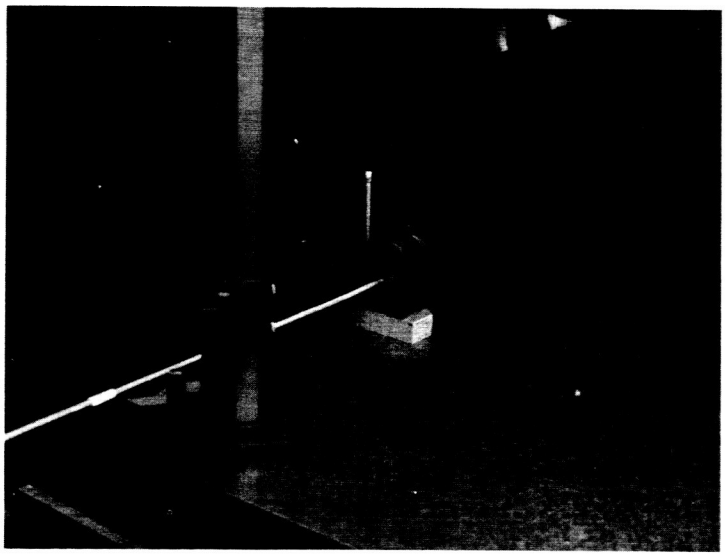


Photo No. 2–Procedure

VII – LEAK TESTS

File No. 500-17

CLW	P.E.
JTS	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH

SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Tape Recorder Leak Test

Date of Test: 24 Oct. & 30 Oct. 1961

Requested by: C. L. Wagner

Performed by: R. Berkeley & R. Breeden

Purpose of Test: To determine leak rate of prototype & serial #5.

Description of Article Tested (Photographs, if any):

Tape Recorder Container

Test Equipment (Photographs, if any):

Veeco Leak Detector

Test Procedure:

1. Pressurize recorder (5 psig).
2. Place standard leak in chamber. Reading was 3×10^{-8}. Set leak indicator to 2.0 on 3.0 scale.
3. Placed recorder in chamber.
4. Pulled vacuum.
5. Reading was $2.5\times3\times10^{-8}$ cc/sec.

Results:

A. Leak rate on F.U. #2 was 2.5×10^{-8}.

B. Leak rate on prototype was too great to get a reading.

Conclusions:

$$\frac{2.4}{X} = \frac{2}{3\times10^{-8}}$$

$$X = \frac{2.4\times3\times10^{-8}}{2}$$

$$X = 5.1\times10^{-8} \text{ std. cc of He/sec.}$$

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-16
CLW P.E.
JTS S.H.
RCB B.H.

INFORMAL TEST REPORT

Name of Test: Tape Recorder Leak & Pressure Test

Date of Test: 26 September 1961

Requested by: Carl Wagner

Peformed by: Paul King & John Sween

Purpose of Test:
1. Determination of leak rate.
2. Determination of deformation of container under pressure. (30 psig max)

Description of Article Tested (Photographs, if any):

Tape Recorder Container

Test Equipment (Photographs, if any):

1. Veeco Leak Indicator.
2. Four Federal Dial Indicators.
3. Plane Table
4. V-Blocks
5. Clamps

Photo #1 – Pressure Test Set-Up

Test Procedure:

I. Leak Test

1. Pressurize recorder container to 20 psig in electrical plug leak.
2. Seal plug with rubber and clamp.
3. Set leak indicator to 0.4.
4. Place recorder in chamber.
5. Leak indicator reading was 10.5.
6. Place standard leak in chamber. Reading was 3×10^{-8}.

II. Pressure Test

1. Tape recorder can was clamped to blocks as shown in Photo #1.
2. Container was pressurized to 30 psig. Pressure was released to 0 psig in 2 psig increments.
3. Readings were taken from the 4 dial indicators at each increment.

Results:

I. Leak rate on recorder:

$$\frac{X}{10.5} = \frac{3 \times 10^{-8}}{.85}$$

$$X = 3.7 \times 10^{-7}$$

II. Pressure Test

See Data Sheet.

Conclusions:

Tape recorder can will withstand 30 psi pressure differential with no major damage. An unsupported container will take a permanent set of 0.015 if subjected to this pressure.

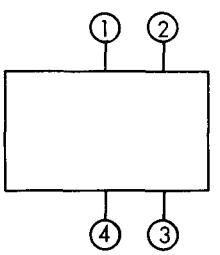
Carl L. Wagner

SHEET_____

S-51

LEAK & PRESSURE TEST OF TAPE RECORDER CAN.

	INDICATOR NO.						INDICATOR POSITION	
Psig	1	2	3	4			ON CONTAINER	
0	0	0	0	0			1	TOP CENTER
2	0.021	0.001	0.003	0.005			2	TOP 2.5" FROM
4	0.032	0.002	0.004	0.008				CENTER
6	0.0455	0.0025	0.007	0.012			3	BOTTOM 2.5" FROM
8	0.0565	0.0035	0.007	0.0165				CENTER
10	0.066	0.004	0.0115	0.021			4	BOTTOM CENTER
12	0.074	0.005	0.014	0.0255				
14	0.0805	0.0055	0.016	0.029				
16	0.087	0.006	0.019	0.034				
18	0.092	0.007	0.021	0.0375				
20	0.098	0.0075	0.0235	0.0425				
22	0.1035	0.0085	0.026	0.048				
24	0.109	0.0095	0.0295	0.055				
26	0.1135	0.010	0.0335	0.063				
28	0.1185	0.0115	0.038	0.073				
30	0.123	0.0125	0.0425	0.082				
28	0.121	0.012	0.041	0.079				
26	0.117	0.012	0.0385	0.0745				
24	-	-	-	-				
22	0.1095	0.011	0.034	0.0665				
20	0.106	0.0105	0.032	0.0625				
18	0.103	0.010	0.0305	0.060				
16	0.097	0.0095	0.028	0.055				
14	0.0915	0.009	0.0255	0.0505				
12	-	-	-	-				
10	0.0835	0.008	0.0225	0.045				
8	0.070	0.007	0.0185	0.037				
6	0.061	0.006	0.016	0.033				
4	0.050	0.005	0.0135	0.023				
2	0.0415	0.0045	0.0125	0.021				
0	0.0145	0.0025	0.008	0.0185				



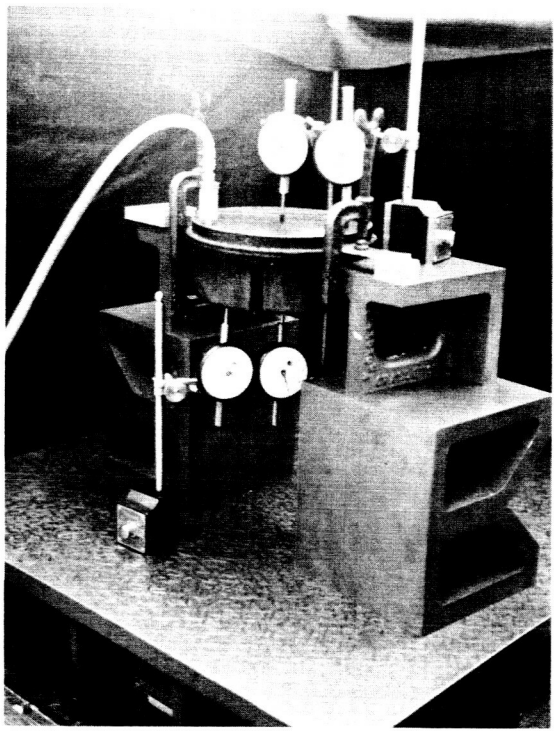


Photo No. 1—Pressure Test Set-Up

VIII - WIRE OUTGASSING

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-45

TWF	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Wire Outgassing Tests

Date of Test: 26 July '61 - 3 Aug '61

Requested by: Flatley

Performed: Peterson - Flately

Purpose of Test: To determine relative outgassing properties of various type of electrical wire in a vacuum environment.

Description of Article Tested (Photographs, if any):

3 foot lengths of:

1. Black poly-vinyl coated wire
2. Teflon coated wire
3. Violet polyolothene coated wire
4. Dark blue nylon-teflon microdot cable.

Test Equipment (Photographs, if any):

Heptavac Chamber #7
D.C. Power Supply
Cu-Cnstn Thermocouple
Precision Balance
Cup formed from "Reynolds Wrap"
Glass Slide

Test Procedure:

In all cases, the wires were tied into a circular loop and the thermocouple was intertwined so as to have the thermocouple junction against the insulating material. Heat was applied internally by passing a current through the conductor. In the case of the microdot cable the current was passed through both the main conductor and the shield. Wire outgassing was observed by monitoring the ambient pressure in the test chamber in which the wire was suspended.

A summary of the test runs follow on pages 136 and 137.

Results:

See following pages, 136 and 137.

Conclusions:

See following page 137.

The following is a summary of the tests run:

1. Poly-Vinyl Wire In Aluminum Foil Cup

   Recorded: a. Chamber pumpdown curve with wire installed
   b. Wire weight before and after
   c. Cup weight before and after
   d. Chamber pressure variation as the wire was heated from room temp. to 64° C

2. Polyolothene Wire In Aluminum Foil Cup

   Same procedure as above except that an excessive chamber pressure rise limited the maximum temperature applied to 44° C.

3. Teflon Wire In Aluminum Foil Cup

   Same procedure as (1) except that the wire was heated to 70° C.

4. Poly-Vinyl Wire In Aluminum Foil Cup

   Same sample as previously tested. Same procedure as (1) above except that two temperature cycles were run. Peak temp's. were 60° C and 68° C.

5. Poly-Vinyl Wire Near A Clean Glass Slide

   Fresh wire sample. It was preheated at 80° C in a vacuum oven for 2 hours before being tested. The maximum temperature reached during heating was 69° C. The glass slide was weighed and inspected before and after.

6. Microdot Wire Near A Clean Glass Slide

   The wire was placed in the vacuum chamber but the ion pump could not be started. It was then removed, baked for 3 hrs. at 80° C in a vacuum oven, and re-installed in the chamber. Again the pump would not start. The chamber was then connected to the diffusion pump in the "Veeco" leak detector and the wire was heated to 55° C. After this degassing operation the ion pump did start. After pumpdown, a temperature run was made with a max. temp. of 70° C.

The results of the tests run are shown in the curves and the chart enclosed. The following summarizes the results of the individual tests:

1. With the poly-vinyl wire in the chamber, an ambient pressure of 2×10^{-6} Torr was reached in 26-1/2 minutes.* With the chamber empty, this pressure was reached in 12 minutes (Figs. 1 and 2). The pressure was down to 1.2×10^{-6} when the temperature run began. It rose sharply as heat was applied and reached a peak of 2.3×10^{-5} (Fig. 4) at a temp. of 62° C. The temp. was held at approx. this temperature for 10 minutes. During this time the pressure dropped to 1.1×10^{-5}. The wire lost 1.7 mg in weight during the test. The cup used also lost weight (Fig. 6) indicating no condensation of outgassed wire insulation particles.

2. The presence of the polyolothene-insulated wire greatly hampered the ion pump performance. After 60 minutes a pressure of 3.2×10^{-6} had been reached. The empty chamber was pumped to that pressure in 8 minutes. Heat was applied to the wire with the pressure at 3.2×10^{-6} and as a temp. of 44° C was reached, it had risen to nearly 10^{-4} Torr. The test was stopped at that point to avoid damaging the pump (Fig. 5). The wire weight decreased by 2.9 mg during the test but the cup weight remained exactly the same, again indicating no condensation.

3. The pumpdown rate with the Teflon wire installed very nearly matched the curve from test No. 1 (Polyvinyl, Fig 2). Heat was applied with the pressure at 1.6×10^{-6}. The wire was heated to 69° C (Fig. 5) and the maximum chamber pressure was 3.8×10^{-6}. It had decreased to 3.2×10^{-6} (at 69° C) when the test ended. The wire weight loss was 5.2 mg. This sample was exposed to vacuum for 20 hours where the previous two spent only 3 hours in the chamber. The cup lost 3.7 mg during this time.

* T = 0 when pump current is 10 ma (4.6×10^{-5} Torr) .

4. With the previously tested poly-vinyl wire in the chamber (after a long exposure to the atmosphere) a pressure of 3.2×10^{-6} was reached in 25 minutes (Fig. 3). During the initial test, this had required 16 minutes. The empty chamber reached this point in 8 minutes (Fig. 2). Heating was begun with an ambient pressure of 2.6×10^{-6}. This increased to 1.6×10^{-5} Torr as the temp. reached 60°C but dropped to 3.8×10^{-6} as this temp. was maintained for nearly 1 hour. As heat was applied a second time to this wire the pressure rose from 1.1×10^{-6} Torr to 5.0×10^{-6} as the temp. reached 68°C (Curves 2 and 3, Fig. 4). This wire lost 1.9 mg in weight and again, no evidence of condensation was found.

5. With the pre-baked poly-vinyl wire in the chamber, a pressure of 2×10^{-6} was reached in 31 minutes (Fig. 3). This was approx. the same performance seen previously with the original poly-vinyl and the Teflon wires. Heat was applied when the ambient pressure was 1.4×10^{-6}. This rose to 1×10^{-5} as the temp. reached 55°C and then 1.4×10^{-5} at 69°C. The pressure dropped to an equilibrium value of 5.8×10^{-6} Torr at 60°C in about 20 minutes (Fig. 4). No wire weight data was recorded, but the glass slide showed no change in weight. Some definite spotting was observed on the glass however, indicating some contamination of the surface.

6. After initial outgassing of the microdot wire, the chamber was pumped to 2.5×10^{-6} Torr in 18 minutes (Fig. 3). The pumpdown curve was approx. the same as was found with the poly-vinyl and Teflon samples (Fig. 2). After an overnight vacuum soak, the chamber pressure had dropped to 7×10^{-7} Torr. As heat was applied the pressure rose to 3.7×10^{-6} and the temp. to 70°C. The final pressure was down to 1.3×10^{-6} at 66°C. This wire lost 2.6 mg in weight and no contamination of the glass slide was noticeable.

Conclusions:

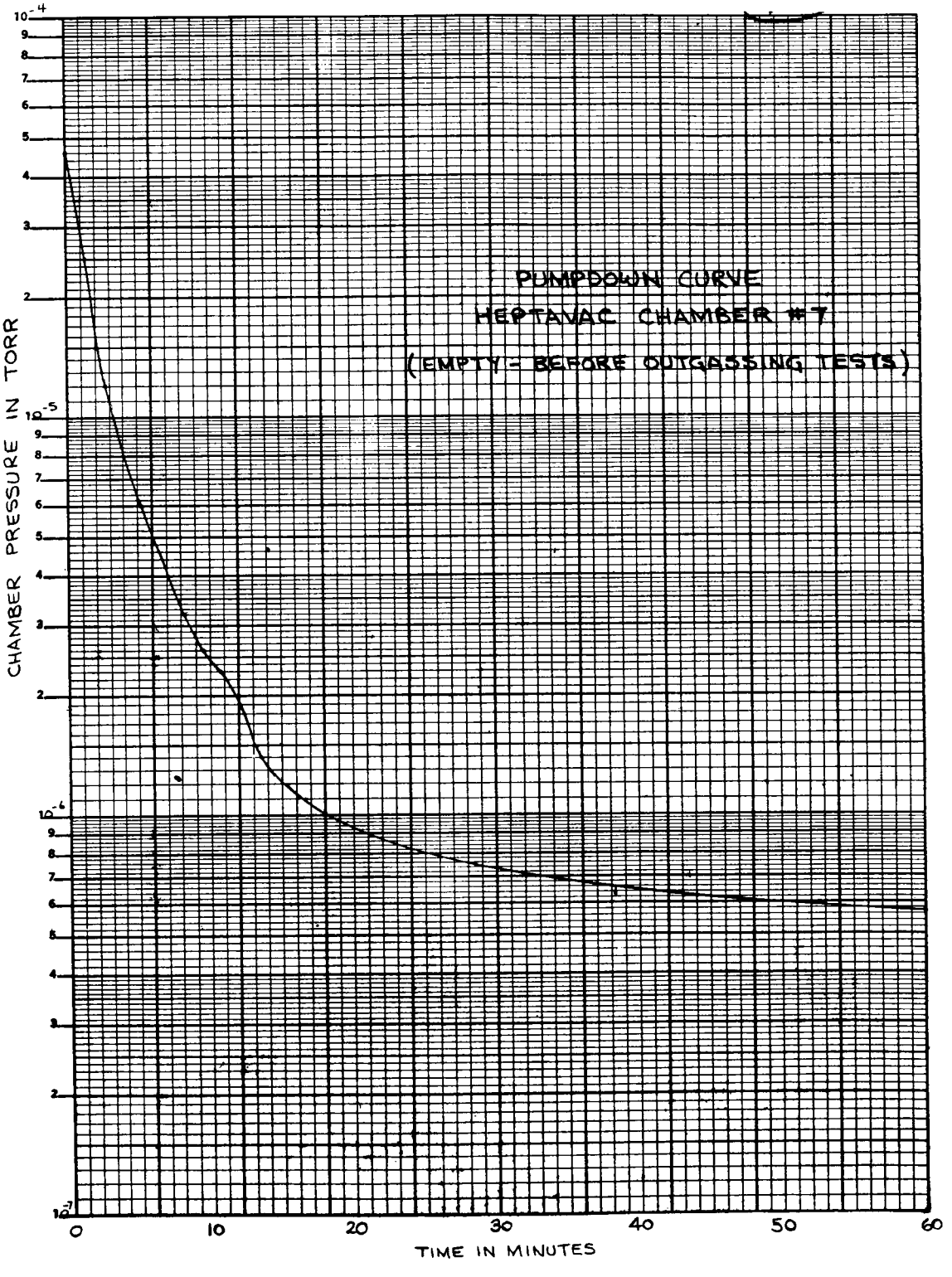
1. The poly-vinyl wire being used in the S-51 harnesses has better outgassing properties than polyolothene but is worse than Teflon.

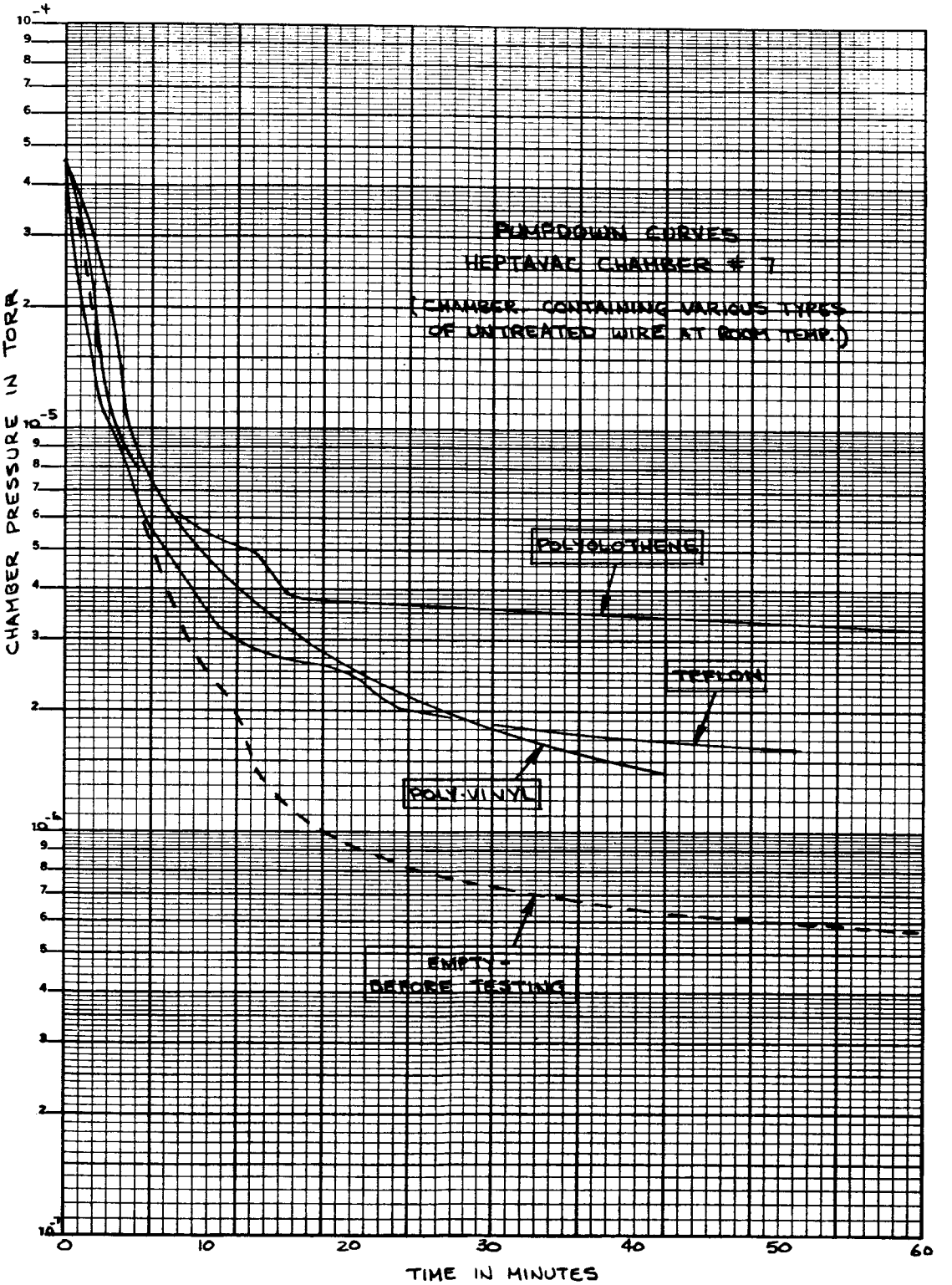
2. The best way to improve the outgassing characteristics of any of the wires is through internal heating, in an ion-pump vacuum system, at the highest practical temperature, for as long as possible.

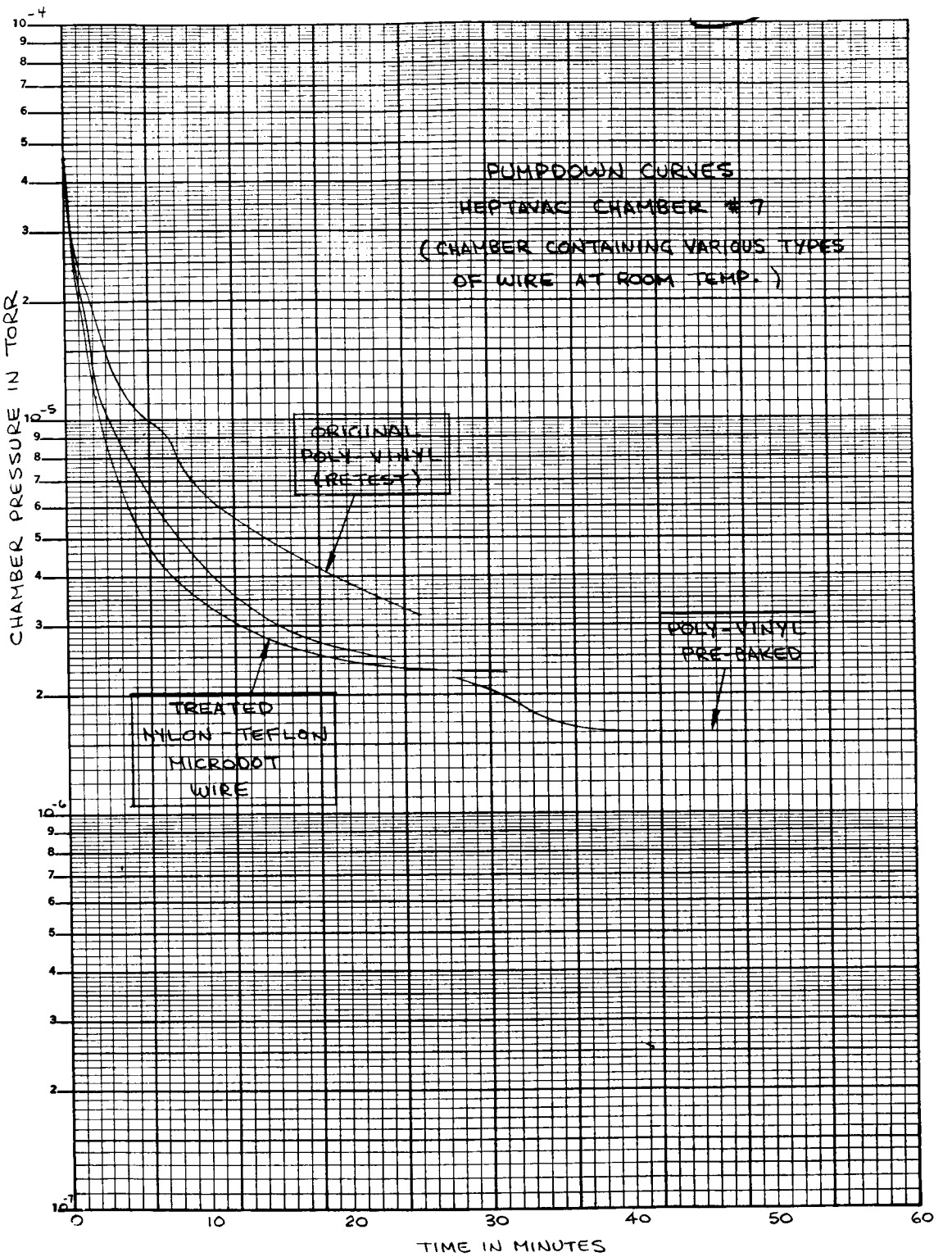
3. External heating, at least in a "soft" vacuum oven, is not very effective.

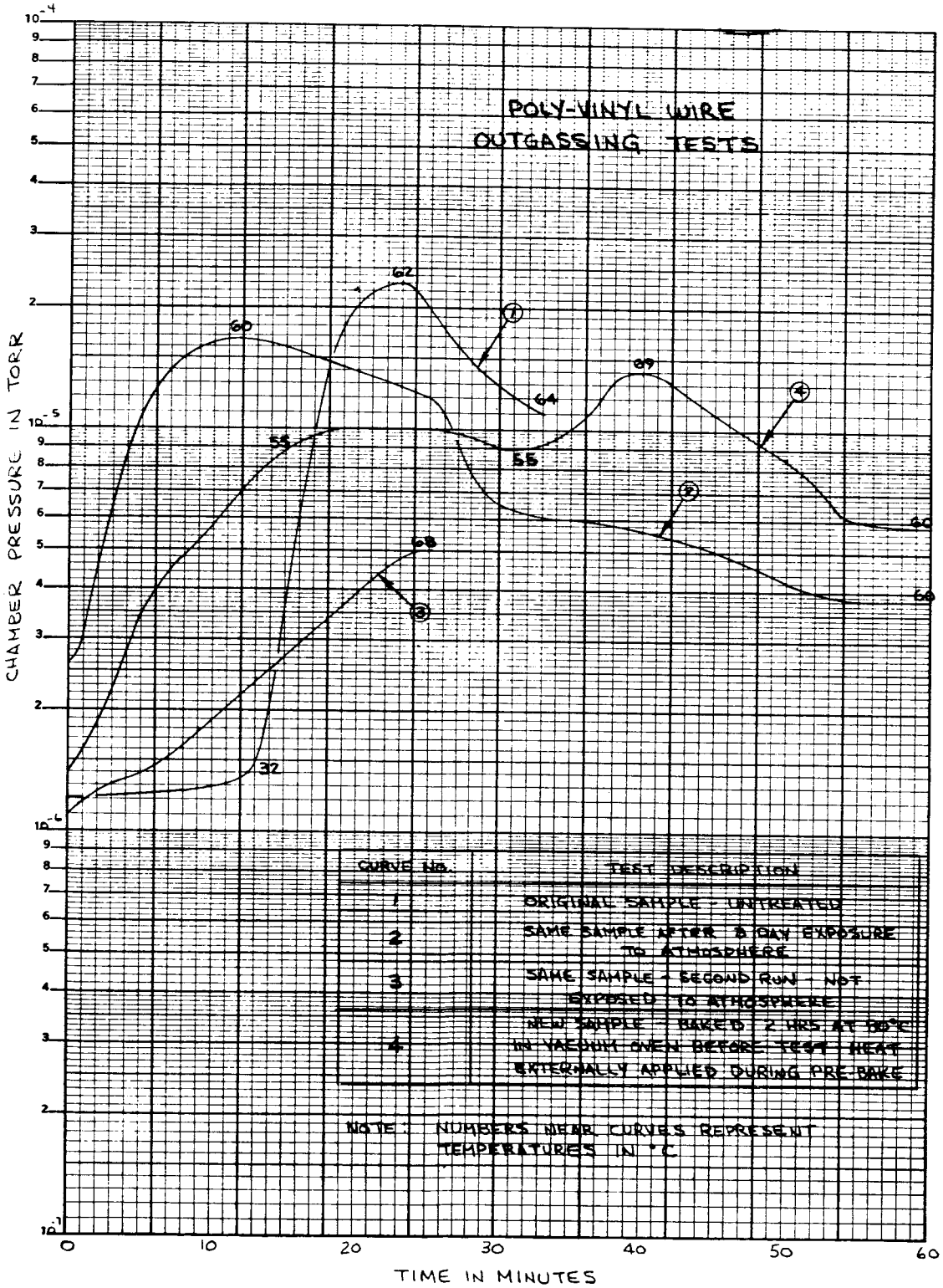
4. The difficulties encountered with the microdot cable indicate that water vapor absorbed in the nylon casing and/or lubricants used in the manufacturing of the cable make it a source of considerable outgassing, but once these volatiles have been driven off, it becomes very good (comparatively).

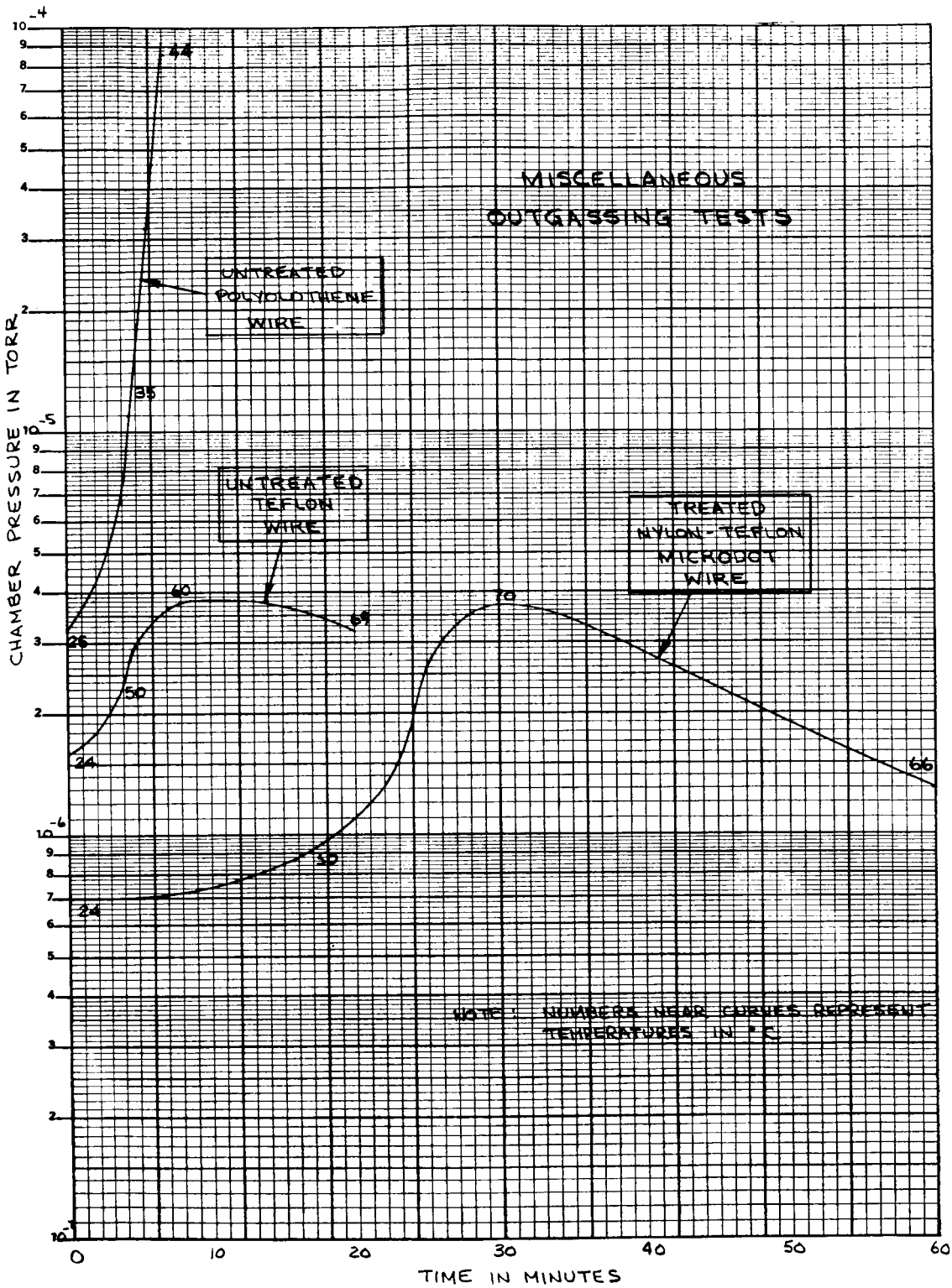
5. Visible contamination of the glass slide did occur in test No. 5 when the pre-baked poly-vinyl was heated to 69°C. Another more closely controlled test may be advisable.


PUMPDOWN CURVE
HEPTAVAC CHAMBER #7
(EMPTY - BEFORE OUTGASSING TESTS)
CHAMBER PRESSURE IN TORR
TIME IN MINUTES
10⁻⁴
10⁻⁵
10⁻⁶
10⁻⁷
0
10
20
30
40
50
60


PUMPDOWN CURVES
HEPTAVAC CHAMBER # 1
(CHAMBER CONTAINING VARIOUS TYPES OF UNTREATED WIRE AT ROOM TEMP.)
CHAMBER PRESSURE IN TORR
TIME IN MINUTES
POLYOLOTHENE
TEFLON
POLY-VINYL
EMPTY - BEFORE TESTING
10^-4
10^-5
10^-6
10^-7
0
10
20
30
40
50
60


PUMPDOWN CURVES
HEPTAVAC CHAMBER #7
(CHAMBER CONTAINING VARIOUS TYPES OF WIRE AT ROOM TEMP.)
ORIGINAL POLY-VINYL (PRETEST)
POLY-VINYL PRE-BAKED
TREATED NYLON-TEFLON MICRODOT WIRE
CHAMBER PRESSURE IN TORR
TIME IN MINUTES
10^-4
10^-5
10^-6
10^-7
0
10
20
30
40
50
60


POLY-VINYL WIRE
OUTGASSING TESTS
CHAMBER PRESSURE IN TORR
TIME IN MINUTES
0
10
20
30
40
50
60
10^{-4}
10^{-5}
10^{-6}
10^{-7}
62
60
64
55
55
69
40
68
60
32
CURVE NO.
TEST DESCRIPTION
1
ORIGINAL SAMPLE - UNTREATED
2
SAME SAMPLE AFTER 8 DAY EXPOSURE TO ATMOSPHERE
3
SAME SAMPLE - SECOND RUN - NOT EXPOSED TO ATMOSPHERE
4
NEW SAMPLE - BAKED 2 HRS AT 100°C IN VACUUM OVEN BEFORE TEST - HEAT EXTERNALLY APPLIED DURING PRE-BAKE
NOTE: NUMBERS NEAR CURVES REPRESENT TEMPERATURES IN °C


MISCELLANEOUS
OUTGASSING TESTS
UNTREATED POLYOLEFIN WIRE
UNTREATED TEFLON WIRE
TREATED NYLON-TEFLON MICRODOT WIRE
CHAMBER PRESSURE IN TORR
TIME IN MINUTES
NOTE: NUMBERS NEAR CURVES REPRESENT TEMPERATURES IN °C.

SUMMARY OF WEIGHT DATA WIRE OUTGASSING TESTS							
TEST NO.	WIRE TYPE	WEIGHT IN GRAMS					
		WIRE			CUP OR SLIDE		
		BEFORE	AFTER	CHANGE	BEFORE	AFTER	CHANGE
1	POLY-VINYL	1.9070	1.9053	-.0017	1.6145	1.6142	-.0003
2	POLYOLOTHENE	2.2181	2.2152	-.0029	0.78805	0.78805	----
3	TEFLON	2.9834	2.9782	-.0052	1.0896	1.0859	-.0037
4	POLY-VINYL (RETEST)	1.9058	1.9039	-.0019	1.6149	1.61485	-.00005
5	POLY-VINYL (PRE-BAKED)	no data	no data	no data	5.7091	5.7091	----
6	MICRODOT (BAKED)	5.5830	5.5804	-.0026	5.7362	5.7365	+.0003

File No. 500-43

TWF	P.E.
JTS	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Electrical Wire Outgassing Test #1

Date of Test: 26 July '61

Requested by: T.W. Flatley

Performed by: Peterson – Flatley

Purpose of Test: To determine the extent of the contamination of surfaces near a heated poly-vinyl coated wire in a vacuum environment.

Description of Article Tested (Photographs, if any):

1 piece poly-vinyl insulated wire (3 ft. long)

Test Equipment (Photographs, if any):

HEPTAVAC-Chamber #7
D.C. Power Supply
Thermocouple
Fine Scale
Cup formed from "Reynolds Wrap" foil.

Test Procedure:

1. Determine pumpdown rate of empty chamber.
2. Weigh wire and cup.
3. Place wire in cup and put both in vacuum chamber.
4. Determine pumpdown rate.
5. Heat wire to 65°C by passing a 2 amp current thru it - plot temp. and chamber pressure vs. time.
6. Weigh wire and cup.
7. Determine pumpdown rate of empty chamber.

Results:

	Before	After	Change
Wire Weight	1.9070g	1.9053g	-.0017g
Cup Weight	1.6145g	1.6142g	-.0003g

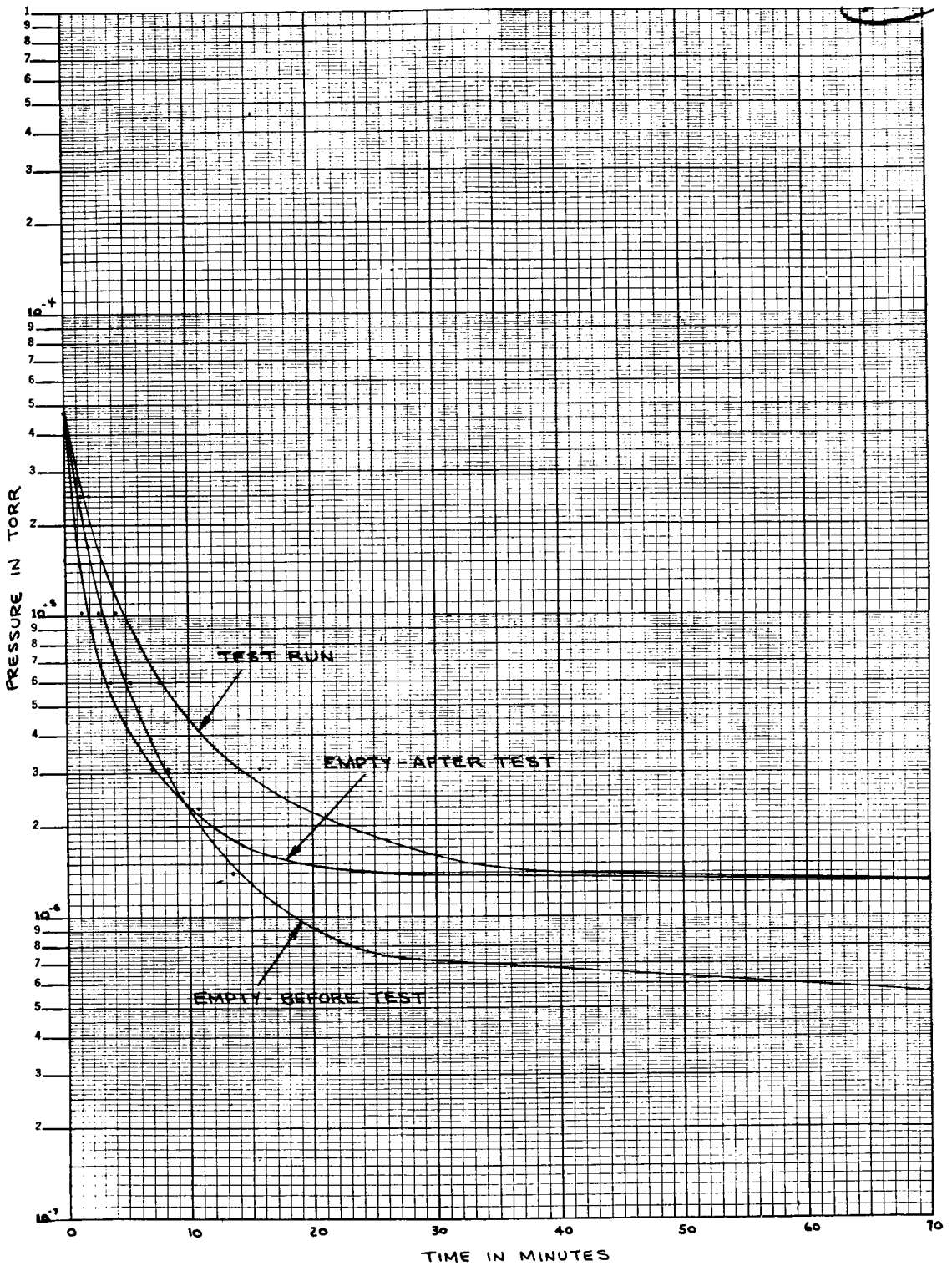
Pumpdown rates – See Fig. 1.

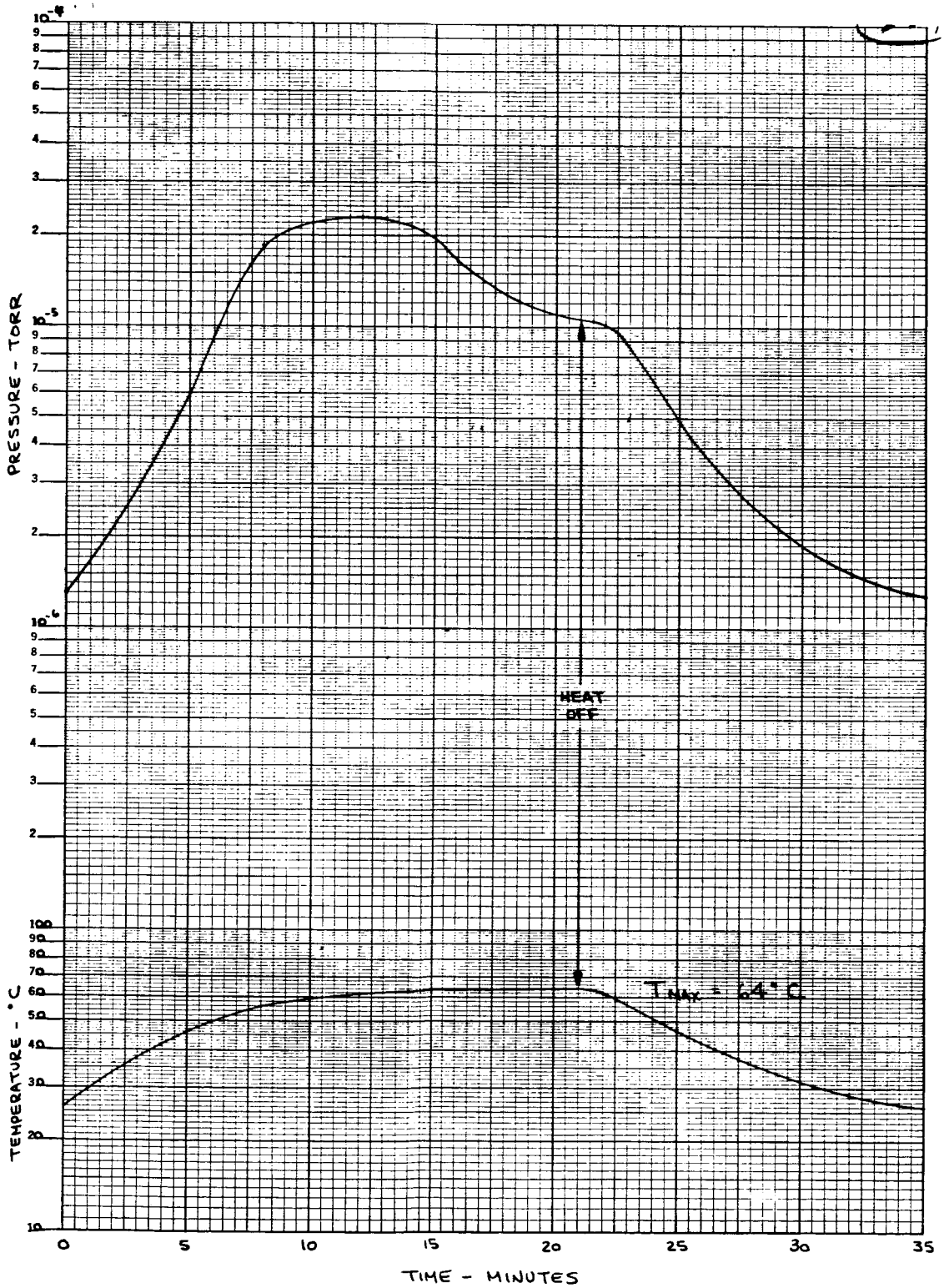
Pressure and Tem. vs. Time – See Fig. 2.

Conclusions:

The occurence of considerable outgassing during this test is evident from the wire weight loss and the curves which have been plotted. The weight loss for the cup however, indicates that outgassed particles did not condense on the cup to any great extent even though a large area was exposed. It appears that these particles bounced around within the cup and the chamber walls (both at approximately room temp) until they entered the pump and were consumed.

The outgassing apparently did contaminate the pump to some extent however, since the empty chamber could not be pumped below 10^{-6} after the test. This contamination prevented the testing of other materials.


PRESSURE IN TORR
TIME IN MINUTES
TEST RUN
EMPTY - AFTER TEST
EMPTY - BEFORE TEST
0
10
20
30
40
50
60
70


PRESSURE - TORR
TEMPERATURE - °C
TIME - MINUTES
HEAT OFF
T_{MAX} = 64° C
0
5
10
15
20
25
30
35

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-43

TWF	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Electrical Wire Outgassing Test #2

Date of Test: 27 July '61

Requested by: T. W. Flatley

Performed by: Peterson - Flatley

Purpose of Test: To determine the outgassing characteristics of a heated polyolefin insulated wire in a vacuum environment.

Description of Article Tested (Photographs, if any):

1 Piece irradiated polyolefin (SR-19) insulated wire (3 feet long). See Exhibit #1.

Test Equipment (Photographs, if any):

HEPTAVAC-Chamber #7
D.C. Power Supply
Thermocouple
Precision Balance
Cup formed from "Reynolds Wrap" foil. (See Exhibit #2)

Test Procedure:

1. Determine pumpdown rate of empty chamber.
2. Weigh wire and cup.
3. Place wire in cup and put both in vacuum chamber.
4. Determine pumpdown rate.
5. Heat wire by passing 2 amp current thru it.
6. Plot temp. and chamber pressure vs. time.
7. Weigh wire and cup.
8. Determine pumpdown rate of empty chamber.

Results:

	Before	After	Change
Wire Weight	2.2181g	2.2152g	-0.0029g
Cup Weight	0.78805g	0.78805g	-0.00000g

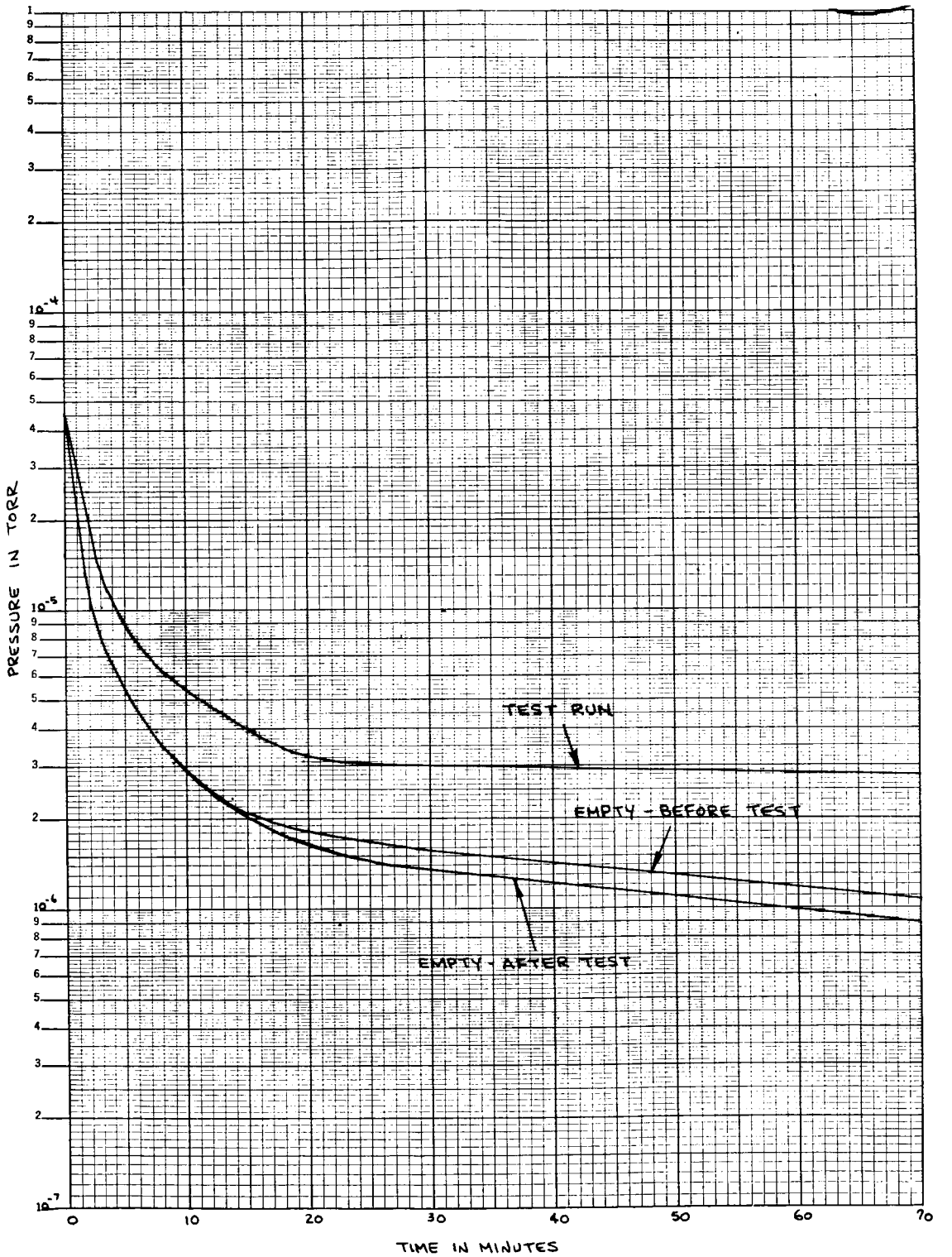
Pumpdown rates – See Fig. 1.

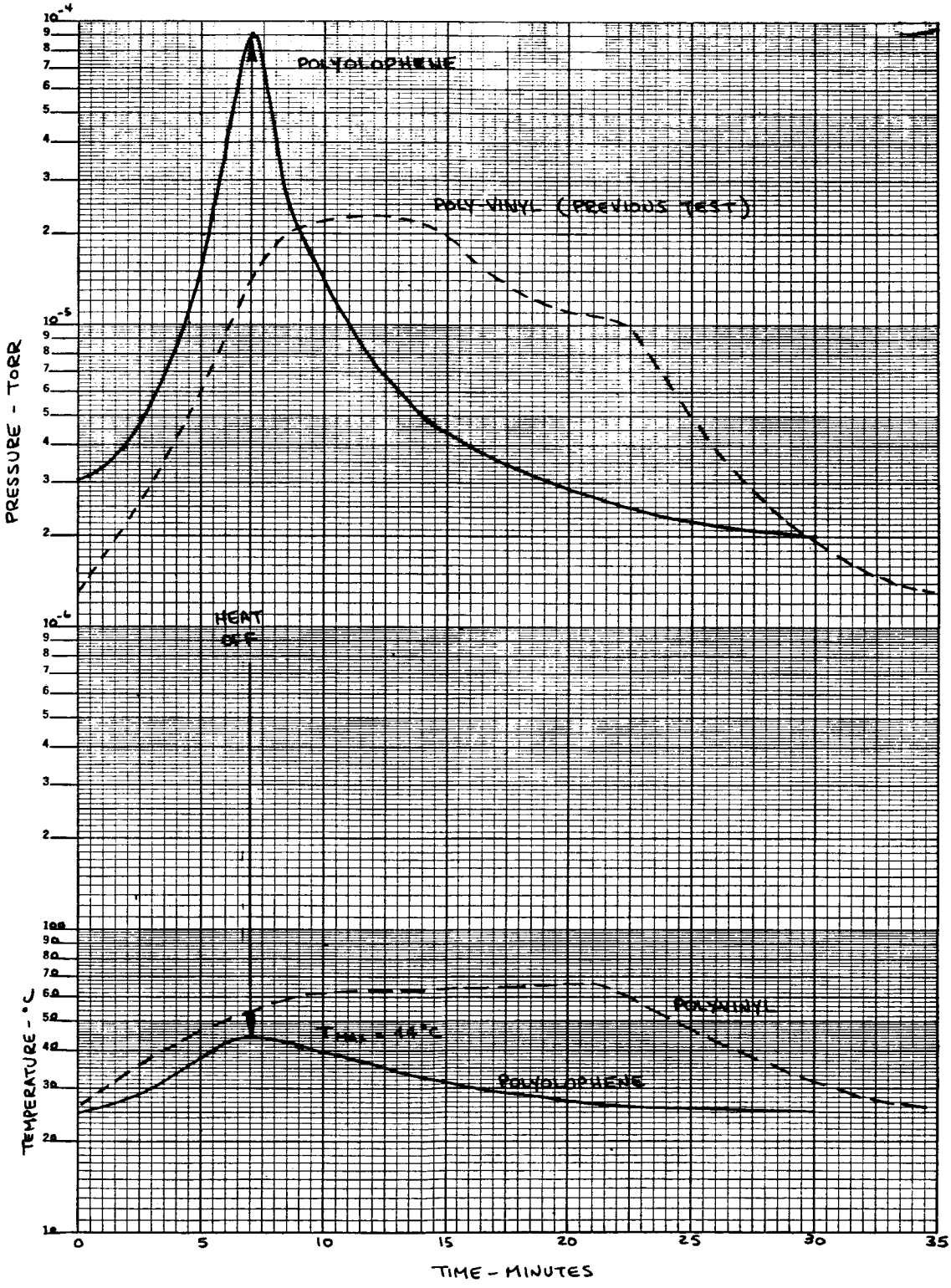
Pressure and Temp. vs. Time – See Fig. 2.

Conclusions:

1. Polyolefin wire outgasses at a much higher rate than poly-vinyl wire.
2. No evidence of condensation of outgassed particles on the aluminum foil cup.

NOTE: The excessive rise in chamber pressure as heat was applied prevented raising the wire temperature above 44°C. Plans had called for 65°C.


PRESSURE IN TORR
TIME IN MINUTES
TEST RUN
EMPTY - BEFORE TEST
EMPTY - AFTER TEST
0
10
20
30
40
50
60
70


POLYOLOPHENE
POLY VINYL (PREVIOUS TEST)
HEAT OFF
PRESSURE - TORR
TEMPERATURE - °C
POLYVINYL
POLYOLOPHENE
TIME - MINUTES
0
5
10
15
20
25
30
35

Summary of Outgassing Tests

The poly-vinyl wire sample was heated in the vacuum chamber three times. A summary of these runs follows:

1. As the wire was heated from 28° C to 60° C, the chamber pressure rose from 1.2×10^{-6} to 2.3×10^{-5} Torr. The temp was held at 60°-65° C for about 10 minutes and the pressure dropped to 1.1×10^{-5}.

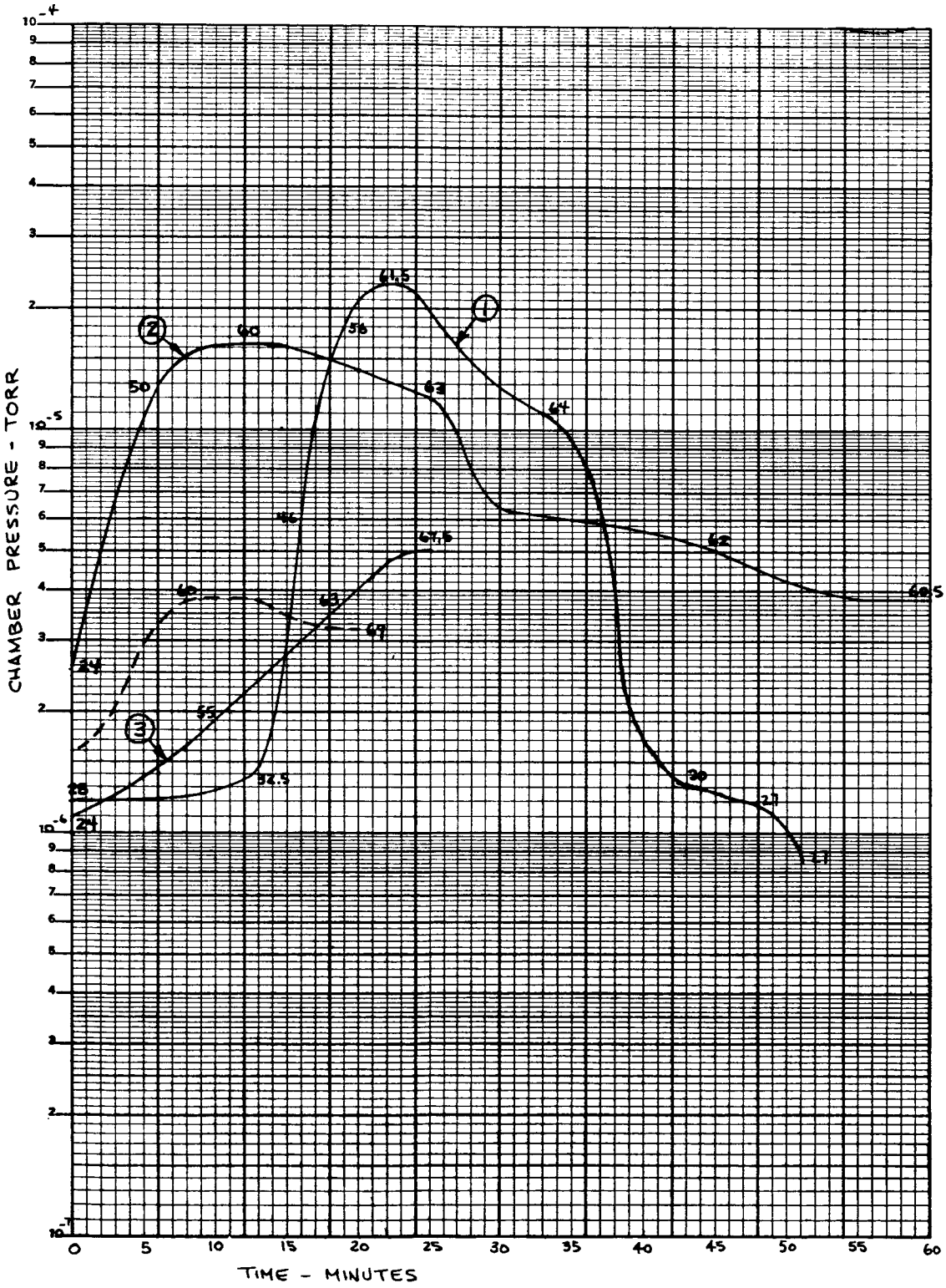
2. The wire was heated from 24° C to 60° C causing a pressure increase from 2.6×10^{-6} to 1.6×10^{-5}. The temperature was maintained at 60° C for 55 minutes and the pressure dropped to 3.8×10^{-6}.

3. The wire was heated from 24° C to 67.5° C and the pressure increased from 1.1×10^{-6} to 5.0×10^{-6}. It seemed to reach equilibrium at this temperature and pressure.

A plot of temperature and pressure vs. time for the three runs is enclosed. The numbers near the curves show the temperature in °C for that point. The dashed line curve shows the results for the Teflon wire during its only test.

These tests show that vacuum heating of the poly-vinyl wire harnesses will improve their outgassing characteristics and reduce the possibility of sensor contamination, but the "conditioned" poly-vinyl will still not be as good as Teflon.

TWR


CHAMBER PRESSURE - TORR
TIME - MINUTES
10⁻⁴
10⁻⁵
10⁻⁶
10⁻⁷
0
5
10
15
20
25
30
35
40
45
50
55
60
1
2
3
50
60
56
61.5
63
64
66
67.5
62
60.5
49
63
67
24
55
32.5
28
24
30
27
21

SHEET 1

CHAMBER NO. 7 WIRE OUTGASSING TESTS

DATA SHEETS

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
1	POLY	VINYL	Before	0	10	4.6×10^{-5}				
				1-15	5	2.5				
				2-45	2	1.1				
				5-15	1	6×10^{-6}				
				8-15	.5	3.2				
				9-30	.4	2.6				
				10-45	.35	2.4				
				13-30	.2	1.4				
				28-30	.1	7.4×10^{-7}				
				1-17-30	.07	5.6				
				3-29-30	.04	3.3				
				4-32-30	.035	3.0				
			Test	0	10	4.6×10^{-5}				
				2-30	5	2.5				
				4-10	2	1.1				
				7-40	1	6.0×10^{-6}				
				15-45	.5	3.2				
				42-00	.2	1.4				
			Temp.	0	.15	1.2×10^{-6}	28			
				12-30	.2	1.4	32.5			
				16-00	1	6.0	46			
				19-00	3.5	1.8×10^{-5}	56			
				23-00	4.5	2.3	61.5			
				27-00	3	1.6	63.5			
				33-00	2	1.1	64			
				43-00	.18	1.3×10^{-6}	30			
				48-00	.15	1.2	27			
				52-00	.12	8.5×10^{-7}	27	3 HRS EXPOSURE		
			After	0	10	4.6×10^{-5}				
				0-30	5	2.5				
				1-15	2	1.1				
				3-45	1	6.0×10^{-6}				
				7-00	.5	3.2				
				24-00	.2	1.4				

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
2	POLYOLEFIN		Before	0	10	4.6×10^{-5}				
				0-30	5	2.5				
				1-25	3	1.6				
				2-10	2	1.1				
				4-30	1	6.0×10^{-6}				
				5-55	.8	5.0				
				7-30	.6	3.8				
				8-55	.5	3.2				
				11-15	.4	2.6				
				13-45	.35	2.4				
				15-15	.3	2.0				
				41-15	.2	1.4				
				1-14-45	.15	1.2				
				1-32-45	.12	8.5×10^{-7}				
			Test	0	10	4.6×10^{-5}				
				1-49	5	2.5				
				2-23	3	1.6				
				3-05	2	1.1				
				8-20	1	6.0×10^{-6}				
				12-55	.8	5.0				
				15-35	.6	3.8				
				1-9-35	.5	3.2				
			Temp.	0	.5	3.2×10^{-6}	25			
				0-45	.5	3.2	26			
				1-50	.6	3.8	27			
				2-40	.8	5.0	28			
				3-00	1	6.0	30.5			
				4-05	1.2	6.7				
				4-30	2	1.1×10^{-5}	34.5			
				5-10	4	2.0				
				5-40	5	3.2	38.5			
				6-00	8	3.8				
				6-15	10	4.6	42			
				7-10	20	8.6	44.5			
				8-50	5	3.2	43			

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
2	POLYOLEFIN		Temp.	9-40	4	2.0	38.5			
				10-47	2	1.1×10^{-5}				
				12-00	1.2	6.7×10^{-6}	36			
				13-00	1	6.0	34.5			
				15-00	.9	5.5	31.5			
				15-50	.6	3.8	30.5			
				16-50	.55	3.4	29.5			
				17-45	.5	3.2	28.5			
				18-45	.5	3.2	28			
				19-55	.4	2.6	27.5			
				30-30	.3	2.0	25	3 HRS EXPOSURE		
			After	0	10	4.6×10^{-5}				
				0-40	5	2.5				
				1-40	3	1.6				
				2-40	2	1.1				
				4-48	1	6.0×10^{-6}				
				5-48	.8	5.0				
				6-48	.6	3.8				
				8-48	.5	3.2				
				11-33	.4	2.6				
				16-33	.3	2.0				
				26-33	.2	1.4				

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
3	TEFLON		Before	0	10	4.6×10^{-5}				
				0-35	5	2.5				
				2-10	2	1.1				
				4-25	1	6.0×10^{-6}				
				6-45	.6	3.8				
				8-15	.5	3.2				
				37-45	.18	1.3				
			Test	0	10	4.6×10^{-5}				
				0-25	7	3.3				
				0-30	6	2.9				
				0-40	5	2.5				
				1-05	4	2.1				
				1-45	3	1.6				
				2-35	2	1.1				
				3-45	1.5	9×10^{-6}				
				5-20	1	6.0				
				7-45	.75	4.5				
				9-15	.6	3.8				
				10-40	.5	3.2				
				18-00	.4	2.6				
				24-15	.3	2.0				
				51-00	.2+	1.6				
			Temp.	0	.2+	1.6×10^{-6}	24			
				1	.2+	1.6	28.5			
				2	.3-	1.8	35.5			
				3	.3	2.0	42			
				4	.4-	2.4	47.5			
				5	.5-	3.0	52			
				6	.5	3.2	55.5			
				7	.5+	3.5	58			
				8	.6	3.8	60.5			
				9	.6	3.8	62.3			
				10	.6	3.8	63.5			
				11	.6	3.8	65			
				12	.6	3.8	65.7			

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
3	TEFLON		Temp.	13	.6	3.8	66.5			
CONTINUED				14	.6-	3.6×10^{-6}	67.5			
				15	.5+	3.5	67.5			
				16	.5+	3.5	68			
				17	.5+	3.5	68.4			
				18	.5+	3.5	68.5			
				19	.5+	3.5	68.6			
				20	.5	3.2	68.8	←		
				21	.5	3.2	65.0			
				22	.4+	2.8	58.0			
				23	.4	2.6	52.0			
				24	.4-	2.4	47.0			
				25	.3+	2.2	42.8			
				26	.3	2.0	39.5			
				27	.3	1.8	36.8			
				28	.3-	1.8	34.6			
				29	.2+	1.6	32.6			
				30	.2+	1.6	31.3			
				31	.2+	1.6	30.0			
			After	NO PUMPDOWN						

Test	Wire	Type	Run	Time	No.7 ma	Press.	Temp.			
4	POLY	-VINYL	Before	0	10	$4.6x10^{-5}$				
	(RETEST)			0-20	8	3.8				
				0-35	6	2.9				
				0-55	5	2.5				
				1-55	3.5	1.8				
				3-10	2	1.1				
				4-30	1.5	$9x10^{-6}$				
				6-00	1	6.0				
				8-30	.75	4.6				
				10-15	.5	3.2				
			Test	0	10	$4.6x10^{-5}$				
				0-20	7.5	3.6				
				0-50	5	2.5				
				2-15	3.5	1.8				
				4-40	2	1.1				
				7-15	1.5	$9x10^{-6}$				
				11-00	1	6.0				
				20-15	.6	3.8				
				25-00	.5	3.2				
			Temp.	0	.4	$2.6x10^{-6}$	24.3			
				1	.5-	3.0	28			
				2	.8	5.0	33.6			
				3	1.1	6.2	39.5			
				4	1.5	9.0	44.5			
				5	1.9	$1.0x10^{-5}$	48.5			
				6	2+	1.3	51.5			
				7	3-	1.5	54			
				8	3-	1.5	55.5			
				9	3	1.6	57			
				10	3	1.6	58			
				11	3+	1.7	59			
				12	3	1.6	59.6			
				13	3	1.6	60.5			
				14	3	1.6	61			
				15	3	1.6	61.5			

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
4	POLY+	VINYL	Temp.	20	2.5	1.4	62.5			
	(RETEST)			25	2+	1.2×10^{-5}	63			
(CONTINUED)				30	1+	6.5×10^{-6}	63+			
				35	1	6.0	63			
				40	.9	5.6	62.2			
				45	.8	5.0	62			
				50	.7	4.2	61.5			
				55	.6	3.8	61.5			
				60	.6	3.8	61.3			
				65	.6	3.8	60.5		HEAT	OFF
				70	.3	2.0	36.5			
				75	.2	1.5	28			
				80	.17	1.3	25			
				85	.15	1.1	24		HEAT	ON
				86	.16	1.2	27.6			
				87	.17	1.3	33.5			
				88	.17	1.3	39			
				89	.18	1.4	43			
				90	.18	1.4	46.5			
				91	.19	1.4	49.2			
				92	.2	1.5	51.2			
				93	.2+	1.6	53			
				94	.25	1.8	54			
				95	.25	1.8	55			
				96	.3	2.0	56.4			
				97	.3+	2.2	57.5			
				98	.35	2.4	58.3			
				99	.4	2.6	59			
				100	.4	2.6	59.4			
				101	.45	3.0	60			
				102	.5-	3.1	61.7			
				103	.5	3.2	63.3			
				104	.6	3.8	64.5			
				105	.6+	3.9	65.5			
				106	.7	4.3	66.4			
				107	.75	4.6	66.8			
				108	.8	5.0	67.2			

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
4	POLY-VINYL		Temp.	109	.8	5.0	67.5			
	(RETEST)			110	.8	5.0	67.5			
(CONTINUED)				180	.15	N.R.	23.5			
				42 hrs.	.04	3.3×10^{-7}	24			
			After	NO PUMPDOWN						

Test	Wire	Type	Run	Time	No.7 ma	Press.	Temp.			
5	POLY-	VINYL	Before	NO	PUMP	DOWN				
	(PRE-	BAKED)								
	2 HRS	AT 80°C)	Test	0	10	4.6×10^{-5}				
				0-45	5	2.5				
				1-15	4	N.R.				
				1-45	3	1.6				
				2-50	2	1.1				
				6-30	1	6×10^{-6}				
				10-00	.75	N.R.				
				15-00	.5-	3.0				
				20-00	.4	2.6				
				25-00	.3+	N.R.				
				30-00	.3+	N.R.				
				40-00	.2+	1.6				
				50-00	.2+	N.R.				
				60-00	.2+	1.6				
			Temp.	0	.2	1.4×10^{-6}	23.5			
				1	.2+	1.6	27.5			
				2	.3-	1.8	32.5			
				3	.4-	2.4	36.5			
				4	.5-	3.0	40.0			
				5	.6-	3.5	42.0			
				6	.65	4.0	44.0			
				7	.75	4.5	45.0			
				8	.8	5.0	46.0			
				9	.85	5.2	47.2			
				10	1-	5.8	49.0			
				11	1	6.0	50.5			
				12	1.2	7.0	52.0			
				13	1.3	7.5	53.0			
				14	1.3	7.5	54.0			
				15	1.5	9.0	54.5			
				16	1.7	9.2	54.9			
				17	1.7	9.2	55.0			
				18	1.9	1.0×10^{-5}	55.0			
				19	1.9	1.0	55.0			

Test	Wire	Type	Run	Time	No.7 ma	Press.	Temp.			
5	POLY-	VINYL	Temp.	20	1.9	1.0	55.0			
	(PRE-	BAKED		21	1.9	1.0×10^{-5}	55.0			
	2 HRS	AT		25	1.9	1.0	55.0			
	80°C)			30	1.5	9.0×10^{-6}	55.0			
				35	1.9	1.0×10^{-5}	62.3			
				40	2.5	1.4	68.8			
				45	2.0	1.1	67.8			
				50	1.05	8.5×10^{-6}	61.8			
				55	1.0	6.0	60.5			
				60	1.0	5.8	60.0			
				73	.4		26.7			
				215	.13		23.5			
			After		NO PUMP DOWN					

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
6	MICRODOT		Before		NO PUMP DOWN					
			Test		NO PUMP DOWN					
			Temp.	0	.09	7.0×10^{-7}	23.6			
				1	.09		24.7			
				2	.09		26.5			
				3	.09		28.5			
				4	.09		30.4			
				5	.09		32.0			
				6	.09		33.5			
				7	.095		34.6			
				8	.1-		35.6			
				9	.1-		36.4			
				10	.1	7.3×10^{-7}	37.1			
				11	.1		37.7			
				12	.1		38.5			
				13	.1+		41.0			
				14	.11		44.2			
				15	.12	8.5×10^{-7}	46.4			
				16	.12		47.6			
				17	.13		49.3			
				18	.14	1.0×10^{-6}	50.4			
				19	.16		51.4			
				20	.17		52.2			
				21	.18		53			
				22	.19		54			
				23	.2+	1.5×10^{-6}	56.8			
				24	.3		59.5			
				25	.4	2.6×10^{-6}	62			
				26	.45		64.1			
				27	.5		65.9			
				28	.5+		67.5			
				29	.6-	3.7×10^{-6}	68.6			
				30	.6-		69.5			
				31	.6-		70.3			
				32	.6-		70.9			

Test	Wire	Type	Run	Time	No. 7 ma	Press.	Temp.			
6	MICRODOT		Before	2120	.5+		73.3			
CONTINUED				2125	.4	2.6×10^{-6}	69.5			
				2130	.3-		67.4			
				2135	.2		66.5			
				2140	.19		66.1			
				2145	.18	1.3×10^{-6}	66.0			
				2300	.075					

IX – ADHESIVE

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-23

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Adhesive Test

Date of Test: 16 Jan '62

Requested by: Carl Wagner

Performed by: Kauffman, Sween

Purpose of Test: To determine a suitable adhesive to bond aluminum to fiberglass.

Description of Article Tested (Photographs, if any):

Shell Epon Resin 931
Epoxylite Resin 810
D.C. Silastic S-5302 & S-5303
Epon 929
Armstrong C7

Test Equipment (Photographs, if any):

Fiberglass strips
Aluminum angles
Blue M oven
F&M Weights

Test Procedure:

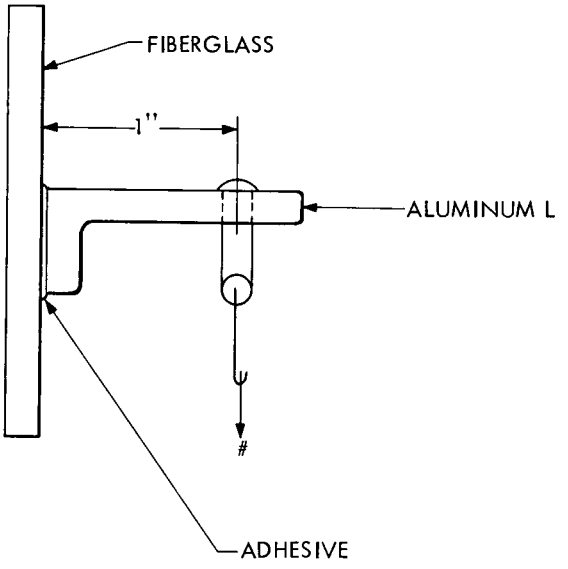
1. Test pieces #1–#5 were mounted on the test fixture in the oven as in Photo #1.
2. Temperature in oven was raised to 425°F.
3. Oven door was opened and 5# load was attached to samples #1–#5.
4. Same procedure for samples #1A–#5A. But one pound loads were used.
5. In second group (1A–5A) temp. was stabilized at 425°F and samples soaked for 20 minutes.
6. After 20 min. oven door was opened. Bond on #1, #3, & #5 had broken.
7. A 2# load was attached to #2 & #4.

Results:

1. After temperature was raised to 425°F, all five bonds broke loose as a 5# load was applied.

See Data Sheet.

Conclusions:



Bonding Surface Area = 1/2-in^2

SHEET_____

S-51 ADHESIVE TEST

Time		Temp.	
Min.		°F	
0		70	
10		258	
15		302	
20		358	
25		372	
30		386	
35		396	
40		406	
45		422	
47		425	OVEN WAS OPENED & A 5# LOAD ATTACHED
			TO EACH SAMPLE. ALL SAMPLES BROKE LOOSE AS WEIGHT
			WAS ADDED.
0		120	
5		260	
10		338	
15		378	
20		410	
25		420	
26		424	
27		353	ONE POUND LOAD ATTACHED TO EACH
30		424	SAMPLE
45		430	SAMPLE NO. 1, NO. 3, NO. 5 APART
50		425	SAMPLES NO. 2, NO. 4 DEFLECTING
51		358	2# LOAD APPLIED TO NO. 2 & NO. 4. BOND BROKE
			ON BOTH

NOTE: AT AMBIENT TEMP. (70°F) ALL HELD NO. 5.

SAMPLE		BONDING AGENT
1	1A	SHELL EPON 931
2	2A	EPOXYLITE 810
3	3A	SILASTIC RTV
4	4A	EPON 929
5	5A	ARMSTRONG C-7

DATA PAPER (11 COLUMN) [illegible]

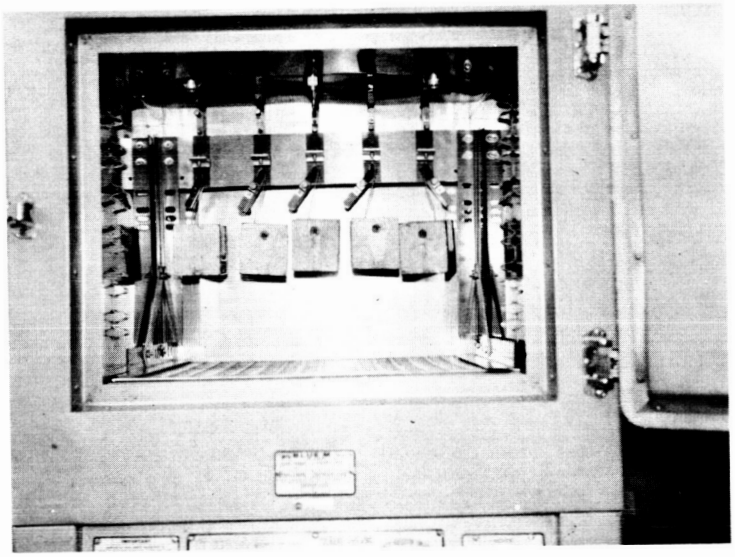


Photo #1 – Test Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-23

CLW	P.E.
JTS	S.H.
RCB	B.H.

Name of Test: Bonding Procedure for 500-23

Date of Test: 12 Jan '62

Requested by:

Performed by: G. W. Moore

Purpose of Test:

Description of Article Tested (Photographs, if any):

Test Equipment (Photographs, if any):

Test Procedure:

#1 Shell Epon Resin 931

1. Parts A&B cured at rm. temp.
2. Surface roughened with 300 grit paper and cleaned with M.E.K.
3. Mix: 100 parts A
   9 parts B

#2 Epoxylite 810

1. Same procedure as #1. Mix: 8 parts A and 1 part B.

#3 Silastic RTV

1. Surface roughened with emery paper and cleaned with M.E.K. D.C. A4014 primer applied and allowed to dry for 30 minutes. Mix: Equal parts A and B.

#4 Epon 929

Preparation same as #1 cured at 250°F for 3 hours. No mix: 1 part resin.

#5 Armstrong C-7

Preparation same as #1
Mix: 100 parts C-7 resin
8 parts Activator A.

Results:

Conclusions:

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-28

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Adhesive Test

Date of Test: 17 Feb '62

Requested by: Carl Wagner

Performed by: J. H. Kauffman

Purpose of Test: Bonding strength of D.C. Silastic RTV S-5 302/5302

Description of Article Tested (Photographs, if any):

D. C. Silastic RTV S-5 302/5302

Test Equipment (Photographs, if any):

See Photo #1
Fiberglass Cylinder
Release Mechanism Spring Holders
Weight Pans
F&M Weights
Blue M Oven
See SK-1

Test Procedure:

1. Prepare samples, see attached test report #500-27.
2. Install cylinder in "Blue M" Oven.
3. Load in 1# increments (20 min. each) until failure.

NOTE: Max. load exerted on bracket by spring is 2-3/4#.

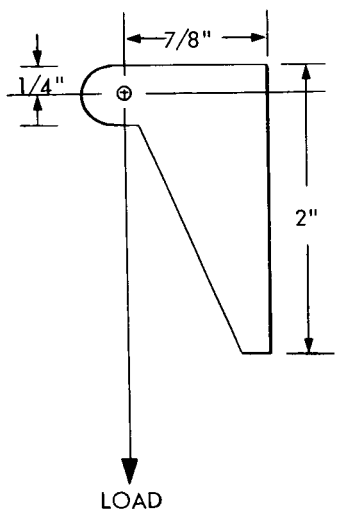
Results:

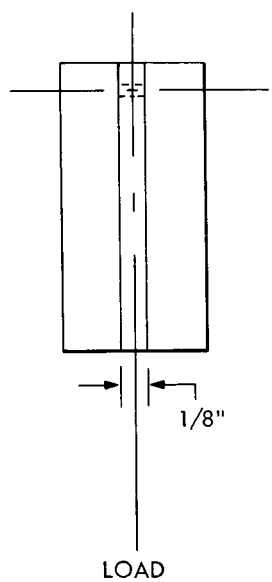
All 4 samples held 24#.

Sample #1 held 25# for 5 minutes.
" #2 " " " 10 " .
" #3 " " " 13 " .
" #4 " " " 10 " .

Conclusions:

SK-1





MATERIAL: Aluminum

Photo #1 – Test Equipment Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-27

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Adhesive Test 500-28

Date of Test: 8 Feb. '62

Requested by: Carl Wagner

Performed by: Moore & Bland

Purpose of Test:

Description of Article Tested (Photographs, if any):

RTV DC 5302/5303

Test Equipment (Photographs, if any):

See Photo #1

Test Procedure:

1. Samples 1,2,3,4 were spaced equal distances apart on fiberglass cylinder.
2. Surfaces cleaned with M.E.K.
3. D.C. A 4014 primer was applied to clean surface and allowed to dry for 30 minutes prior to bonding.
4. Equal parts of A&B were mixed and cured overnight at room temperature.

Results:

Conclusions:

This batch (old one, or first sent by CVC to GSFC) O.K. to use for launch.

Note, however, testing of other batches showed that this material is not reliable as an adhesive. Use RTV 731 for that purpose.

C. L. Wagner

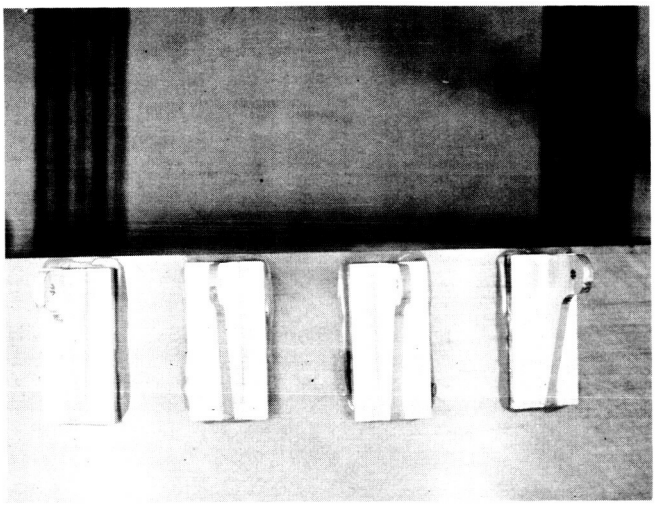


Photo #1 – Bonding Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-38-A

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Adhesive Test

Date of Test: 3-22-62

Requested by: Carl Wagner

Performed by: Shaffer & King

Purpose of Test: To determine load at which adhesive would fail at temperatures of 425° F and 400° F.

Description of Article Tested (Photographs, if any):

4 Aluminum brackets bonded to fiberglass segment.
Two brackets were bonded with D.C. 5302 & 5303.
Two brackets were bonded with RTV 731.

Test Equipment (Photographs, if any):

Weights
Weight Pan
Oven
Photo #1 – Test Equipment Set-up

Test Procedure:

1. Segment with four brackets bonded to it was placed in oven and temp. was brought to 425° F.
2. Weights were added as shown on data sheet to one of each of the samples.
3. Temperature was lowered to 400° F and procedure was repeated on remaining two brackets.

Results:

See Data Sheet.

Conclusions:

1. Suspect latest batch of D.C. 5302/5303.
2. Request use of RTV 731 to bond components to X-248 for launch.

CLW

- D.C. 5302 & 5303 -										
SAMPLE NO. 1										
Time	Load	Temp.								
0 min	5#	425 °F	BROKE IN ELEVEN (11) MINUTES.							
SAMPLE NO. 2										
Time	Load	Temp.								
0 min	3#	400 °F								
20 min	4#	400 °F								
30 min	5#	400 °F								
40 min	8#	400 °F	BROKE IN 49 MINUTES							
- RTV 731 -										
SAMPLE NO. 3										
Time	Load	Temp.								
0 min	5#	425 °F								
20 min	10#	425 °F								
25 min	15#	425 °F	BROKE WHEN LOAD WAS APPLIED							
SAMPLE NO. 4										
Time	Load	Temp.								
0 min	3#	400 °F								
20 min	4#	400 °F								
30 min	5#	400 °F								
40 min	8#	400 °F								
50 min	10#	400 °F								
60 min	15#	400 °F								
65 min	17#	400 °F								
70 min	19#	400 °F								
75 min	21#	400 °F	BROKE IN 77 MINUTES							

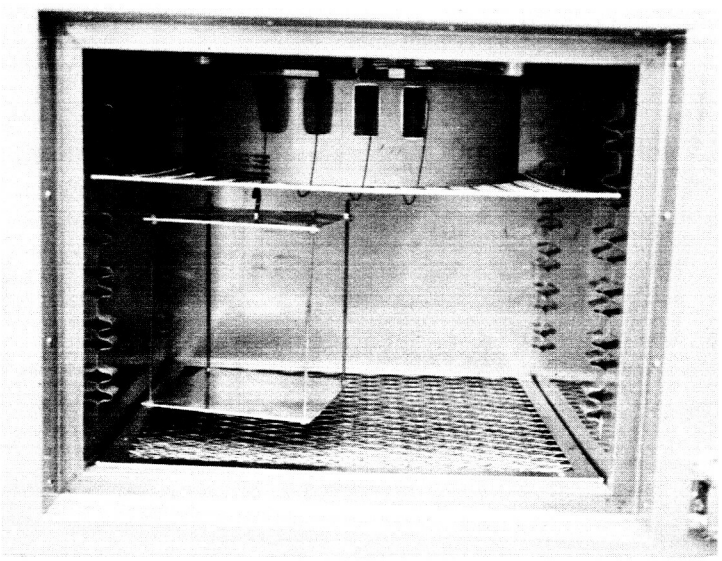


Photo #1 – Test Equipment Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-38-B

CLW	P.E.
JTS	S.H.
RCB	B.H.

Name of Test: Preparation of Samples for 500-38-A

Date of Test: 3-17-62

Requested by: Carl Wagner

Performed by: Moore & Spencer

Purpose of Test:

Description of Article Tested (Photographs, if any):

Test Equipment (Photographs, if any):

Test Procedure:

I. D.C. 5302/5303

1. Clean brackets 1 & 2 with Toluene and fiberglass surface with M.E.K. Wipe both with clean dry cloth and allow to air dry for 15 min.
2. Apply Dow Corning Primer A4014 and let air dry for 30 min.
3. 3. Apply D.C. 5302/5303 to primed surface in a uniform thickness of 10-30 mils. Put sample in place, using enough pressure to displace the air only.
4. Cure for 24 hrs.
5. Age for 48 hrs.

II. RTV 731

1. Same procedure as used with D.C. 5302/5303 except that RTV 731 was used instead of D.C. 5302/5303.

Results:

See Test Report #500-38-A.

Conclusions:

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-44

CLW	P.E.
JTS	S.H.
RCB	B.H.

Name of Test: Bonding Wood to Plexiglass

Date of Test: 30 Nov. 1960

Requested by: Carl Wagner

Performed by: J. H. Kauffman

Purpose of Test: To find a clear and strong bonding agent. Comparison test of available bonding agents. Make samples to show the clearness of the bonding agent.

Description of Article Tested (Photographs, if any):

1. Pliobond (Goodyear)
2. 57-04 Polystyrene Cement (Walso Electronics)
3. 40-2 Acrylic Cement (General Cement)
4. Arrowhead Cement (Webb Products)
5. Duco Cement (DuPont)

Test Equipment (Photographs, if any):

Dillon Universal Testing Machine (300# cap.)
SK-1 of samples.

Test Procedure:

10 samples of each agent in shear
10 samples of each agent in tension

1. Bond flat surfaces (1 in^2 area) and apply five pounds pressure on sample and cure for 24 hours. Apply load in Dillon testing machine. Record load when failure occurs.
2. Bond end surfaces (.44 in^2 area) and apply five pounds pressure and cure for 24 hours. Apply tension load and record load when failure occurs.

NOTE: Surfaces of samples were sanded smooth.

Results:

	Shear Test	Tension Test
Pliobond	60#/in^2	68#/in^2
* Polystyrene Acrylic	200#/in^2	160#/in^2
A. Arrowhead	235#/in^2	145#/in^2
A. Duco	255#/in^2	230#/in^2

NOTE: Twinweld & Hysol are not clear but were tested in shear and tension. Loads = Approx. 115#/in^2.

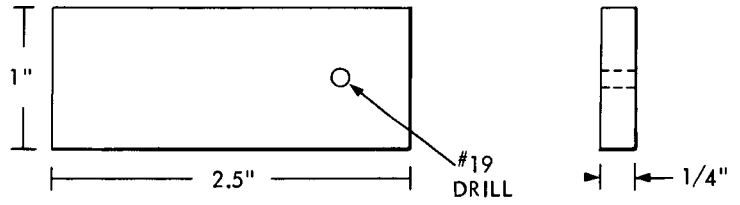
A. 25% of samples withstood more than 300#/in^2.
* Will not bond materials together to give a load test.

Conclusions:

The best and clearest bonding agent is Duco. JHK.

Specimens are on file.

1



SK-1

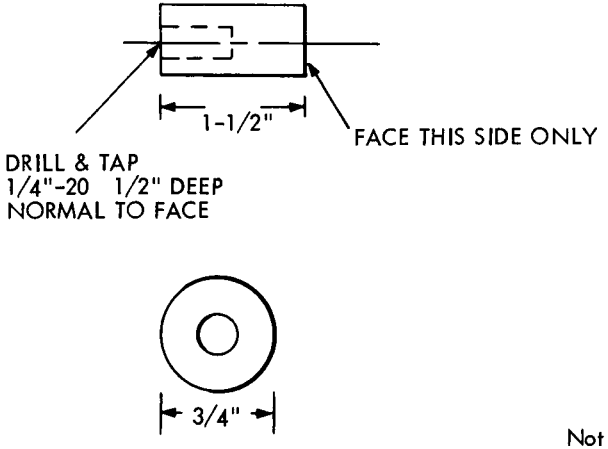
Material: 1/4" Plywood
: 1/4" Plexiglass

Make 50 pcs each.
Saw cut on sides.

2

Material: 3/4" Dia.
Plexiglass

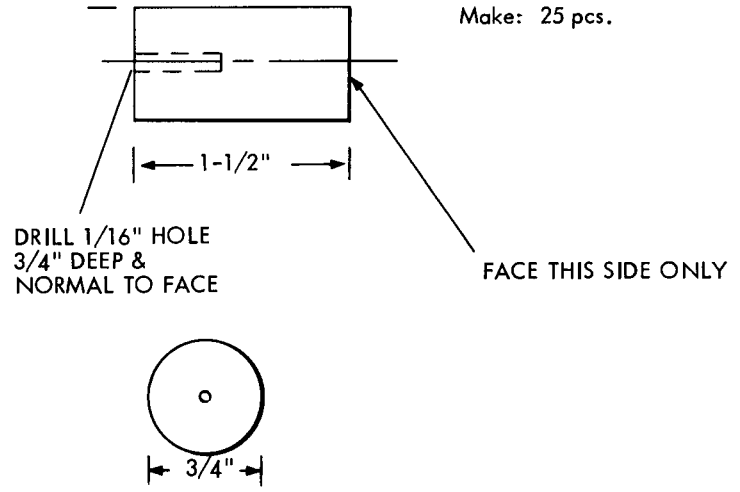
Make: 25 pcs.



3

Material: 3/4" Dia.
Wood Dowel

Make: 25 pcs.



Not to Scale

X - HOIST HANDLING FIXTURE

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-7

RT	P.E.
CLW	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Qualification of Hoist Handling Fixture

Date of Test: 22 & 23 May '61

Requested by: R. Treadwell

Performed by: Pierro & Dallatore

Purpose of Test: To determine structural integrity

Description of Article Tested (Photographs, if any):

Frustrum of a cone shape, 16" high, 8" diam. at base, 3/4" O.D. tubing welded assembly, eye bolt at top and 4 shear-pin-clevis bolt combinations at base.

Test Equipment (Photographs, if any):

1. Chain Fall
2. A-Frame
3. Dial indicators
4. 100# Spring Scale
5. Test Fixture for Cantilever
6. Weight Pans
7. 450# Lead Weights (F&M)

Test Procedure:

Three tests were conducted

Tests #1 and #2 were cantilever.
Test #3 was axial load.
See SK-1 for lug configuration in #1 & #2.

Test #1

1. Handling fixture was mounted to a 3/16" aluminum plate with 4 #10-32 machine screws.
2. Aluminum plate was mounted to A-Frame. See Photo #1.
3. One end of spring scale was hooked to eye bolt and other end to chain fall.
4. Dial indicators were mounted as shown in Photo #2.
5. Deflection readings were taken in 10# increments from 0-100#.

Test #2

Same as Test #1 except for lugs. See SK-1.

Test #3

450# was affixed to fixture and raised 12" from floor. See Photo #3.

Results:

See Data Sheet.

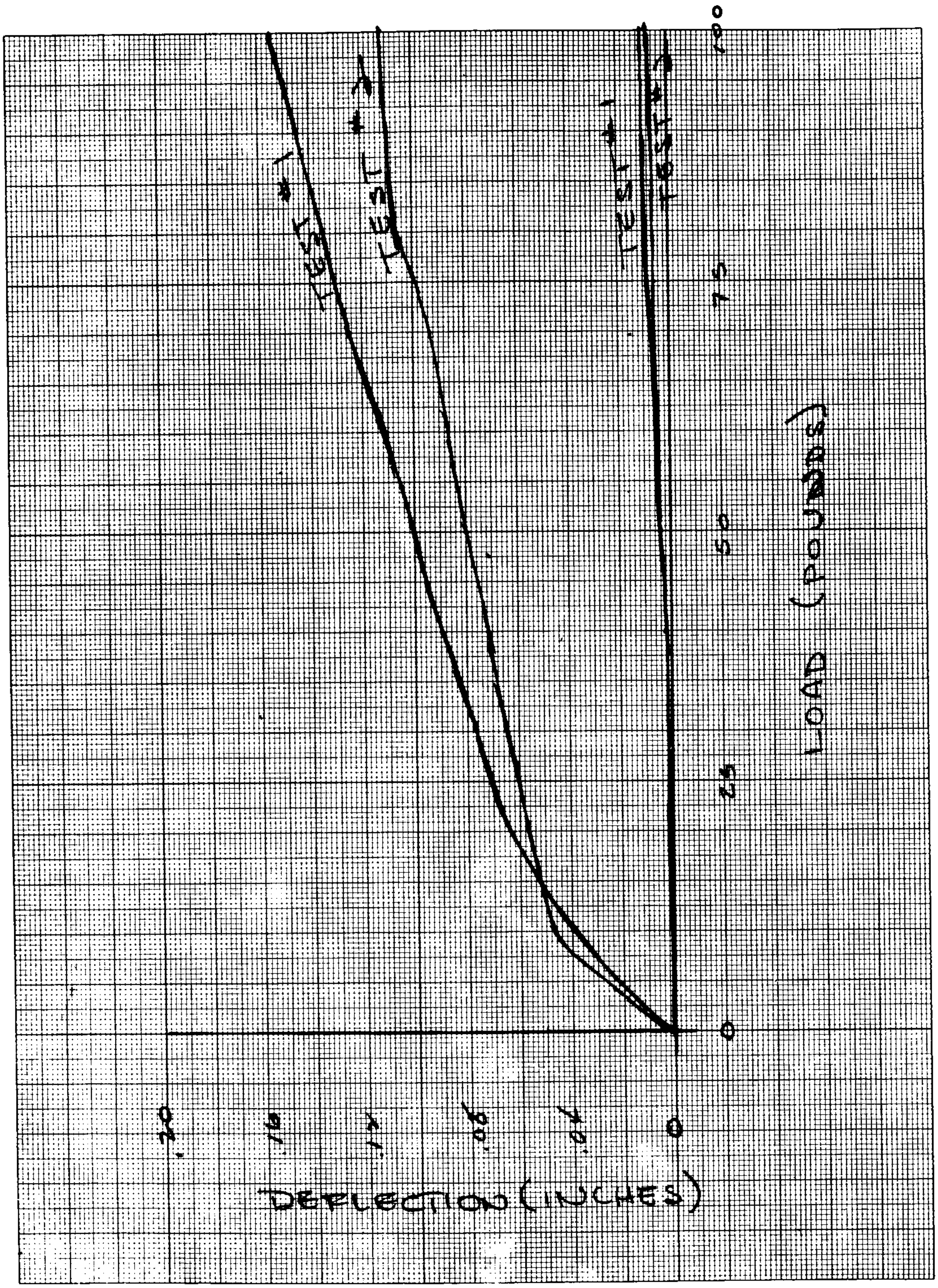
Conclusions:

Fixture meets requirements set forth for lifting and handling the S-51 satellite.

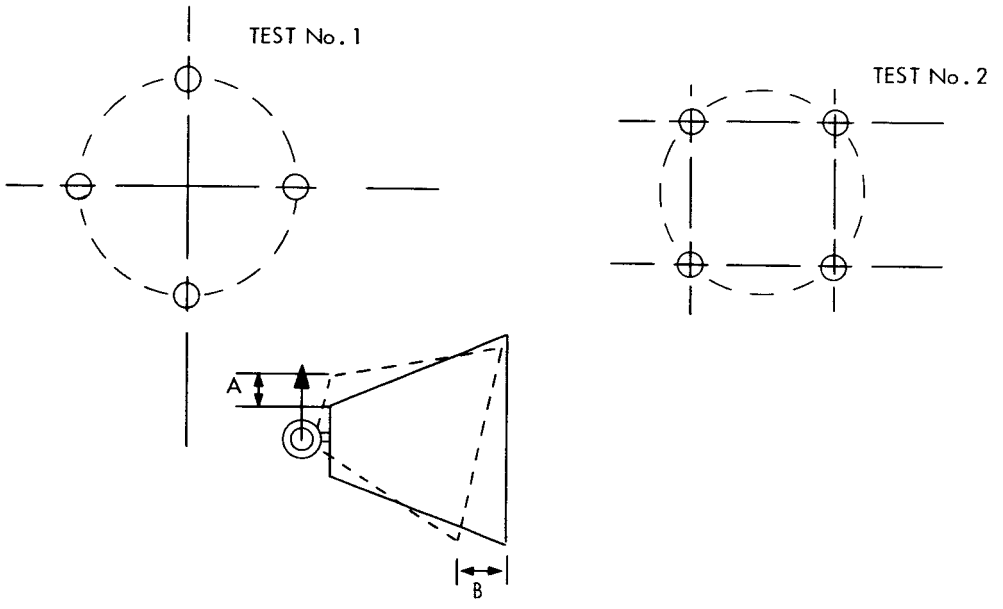
Recommendations:

A. Remaining two fixtures are to be manufactured as designed.

B. Each fixture is to undergo same tests outlined or described by this report and test request.


TEST #1
TEST #2
TEST #1
TEST #2
0
25
50
75
100
LOAD (POUNDS)
DEFLECTION (INCHES)

SK - 1



SHEET_____

HOIST HANDLING FIXTURE

TEST NO. 1

Load	"A"	"B"	→ SEE SK-1
0	.000	.000	
10	.040	.000	
20	.064	.000	
30	.077	.001	
40	.090	.002	
50	.100	.004	
60	.112	.005	
70	.125	.007	
80	.135	.009	
90	.145	.010	
100	.155	.010	

TEST NO. 2

Load	"A"	"B"	→ SEE SK-1
0	.000	.000	
10	.047	.000	
20	.057	.000	
30	.065	.0015	
40	.072	.003	
50	.080	.004	
60	.087	.005	
70	.093	.006	
80	.107	.006	
90	.110	.007	
100	.112	.008	

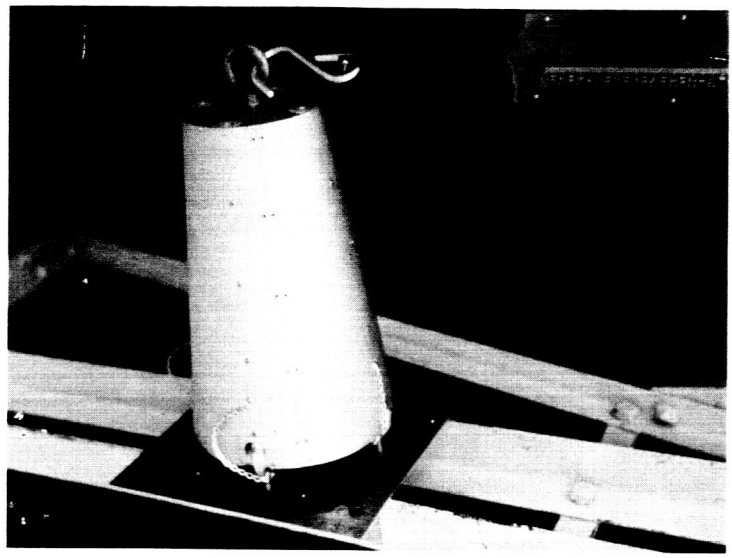


Photo #1 – Test Set-Up

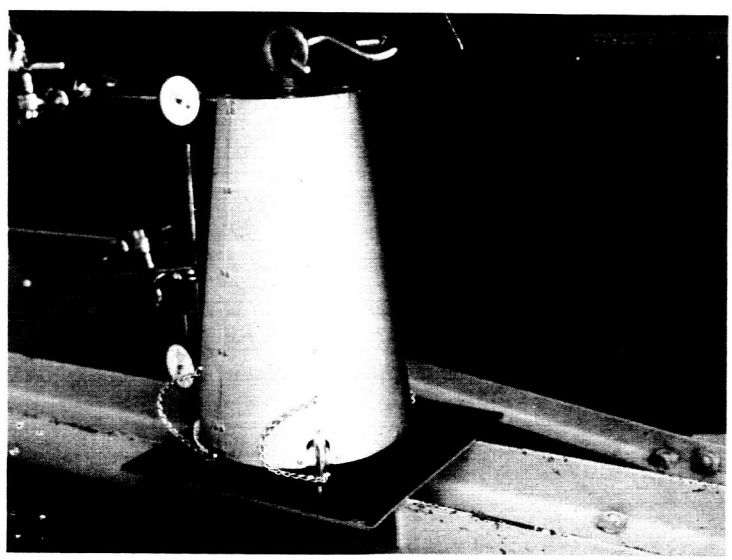


Photo #2 – Dial Indicator Set-Up

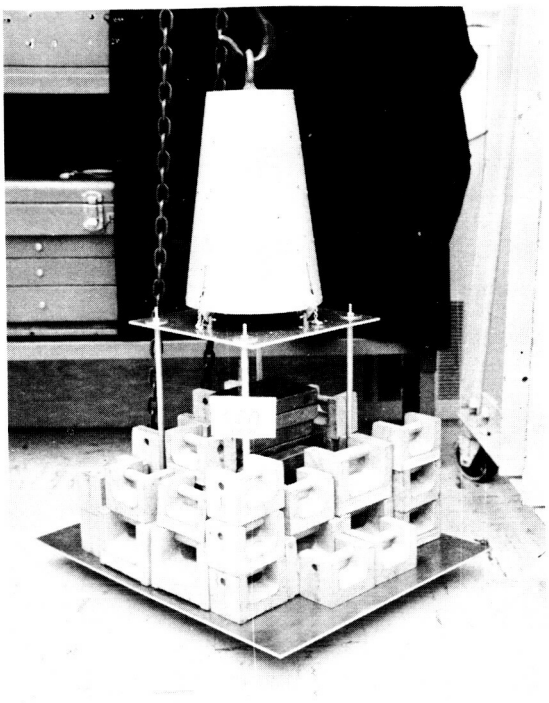


Photo No. 3–Axial Load Set-Up

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-9	
RT	P.E.
CLW	S.H.
RCB	B.H.

Name of Test: Qualification of Hoist Handling Fixture

Date of Test: 13 July '61

Requested by: R. Treadwell

Performed by: Tony Pierro

Purpose of Test: To determine if specimens are sturdy.

Description of Article Tested (Photographs, if any):

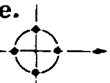
Frustrum of a cone, 15" high, 8" diam. at base, 3/4" O.D. tubing welded assembly, 1/2" eye bolt at top, and 4-3/16" aluminum shear pin-clevis bolt combination at base. 2 specimens - FL.U.#1, FL.U.#2.

Test Equipment (Photographs, if any):

1. Chain Fall
2. A-Frame
3. Dial Indicators
4. Test Fixture for Cantilever
5. Weight Pan
6. 450# Weights. F&M

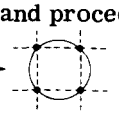
Test Procedure:

In all, six tests were made.

1. Test #1. Cantilever  Bolt Circle at base.

Weights were added in 10# increments from 0-100#. Deflection was noted at each increment. Permanent deflection was noted. F.U. #1.

2. Test #2. Same setup and procedure, except

Bolt Circle at base was  F.U. #1.

3. Tests #3 & #4 were the same as #1 & #2 respectively using F.U. #2.
4. Tests #5 & #6 were axial load tests of F.U. #1 & F.U. #2, respectively with 450# load merely raised 12" from floor. No deflection was measured.

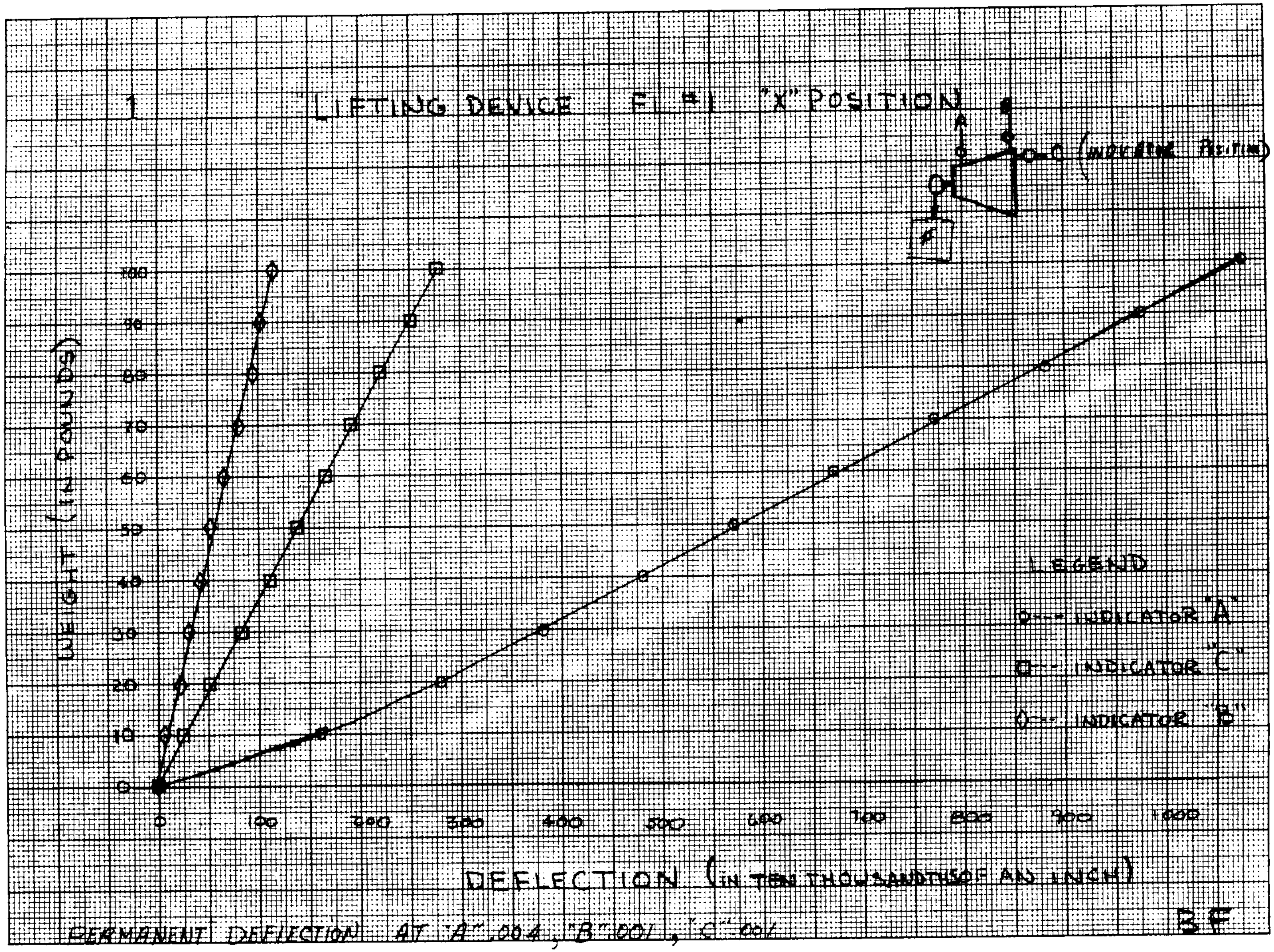
See Data Sheets & Diagrams.
See Photo #1 – Cantilever Load
See Photo #2 – Axial Load

Results:

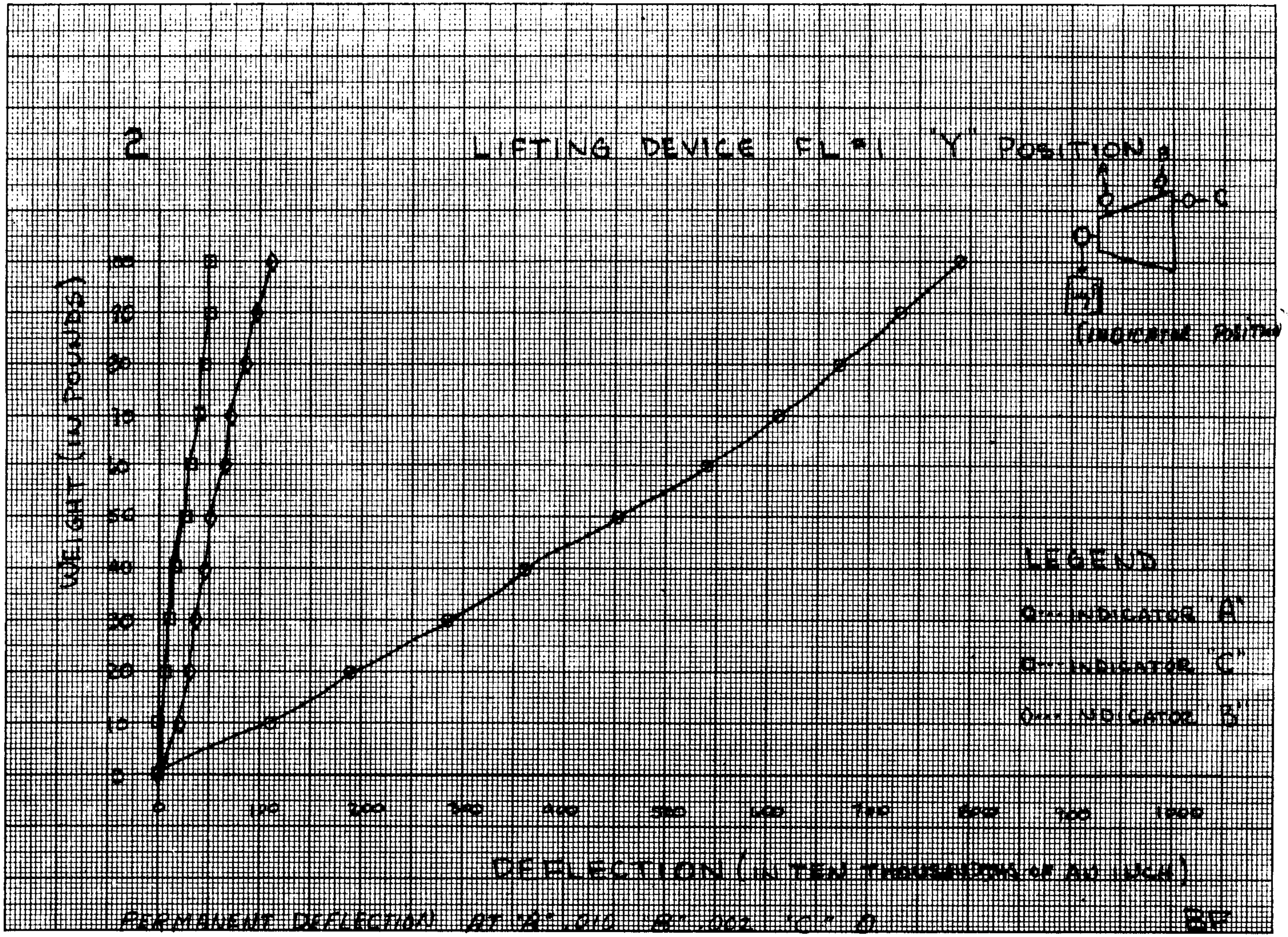
See Data Sheets & Graphs.

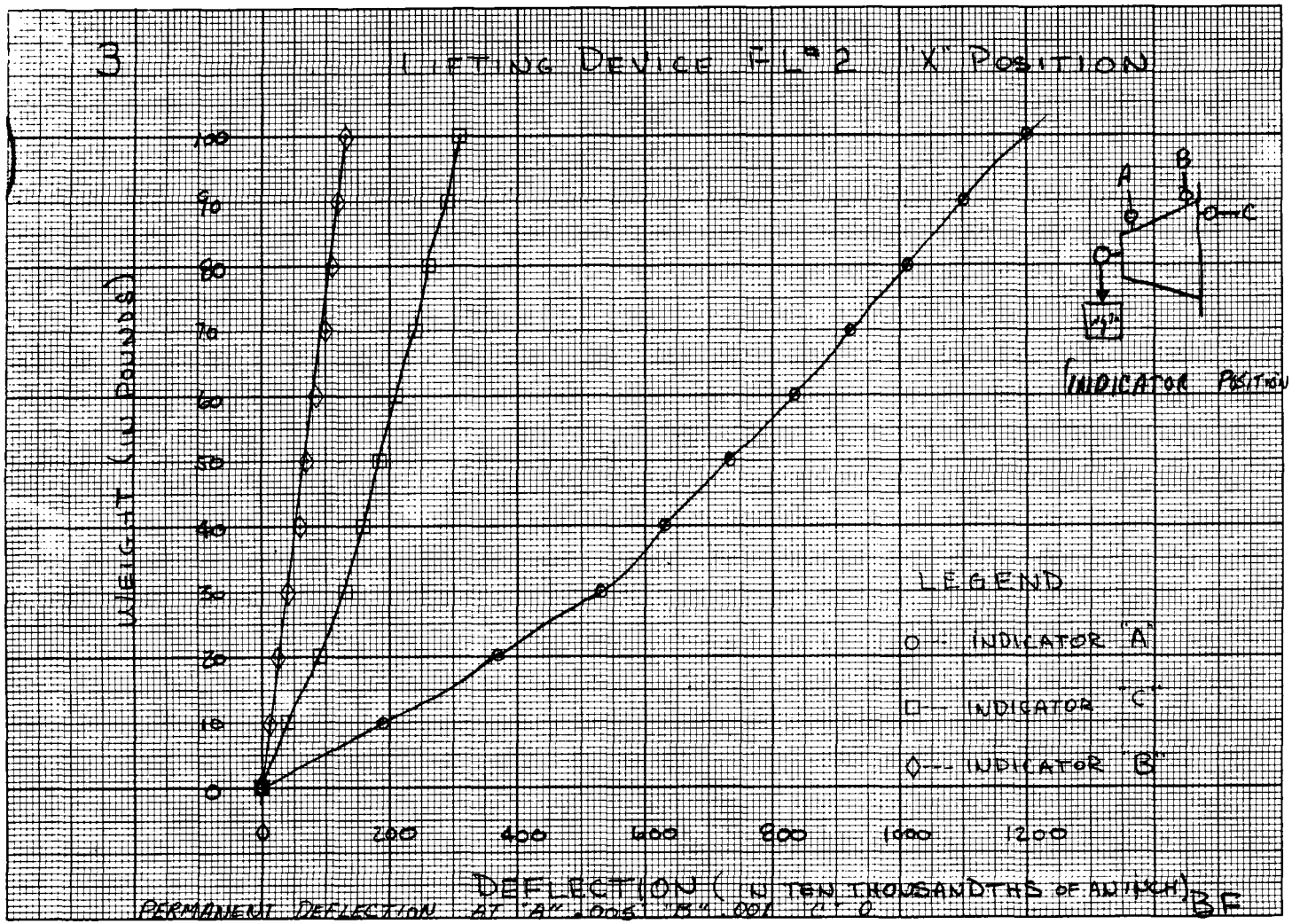
Conclusions:

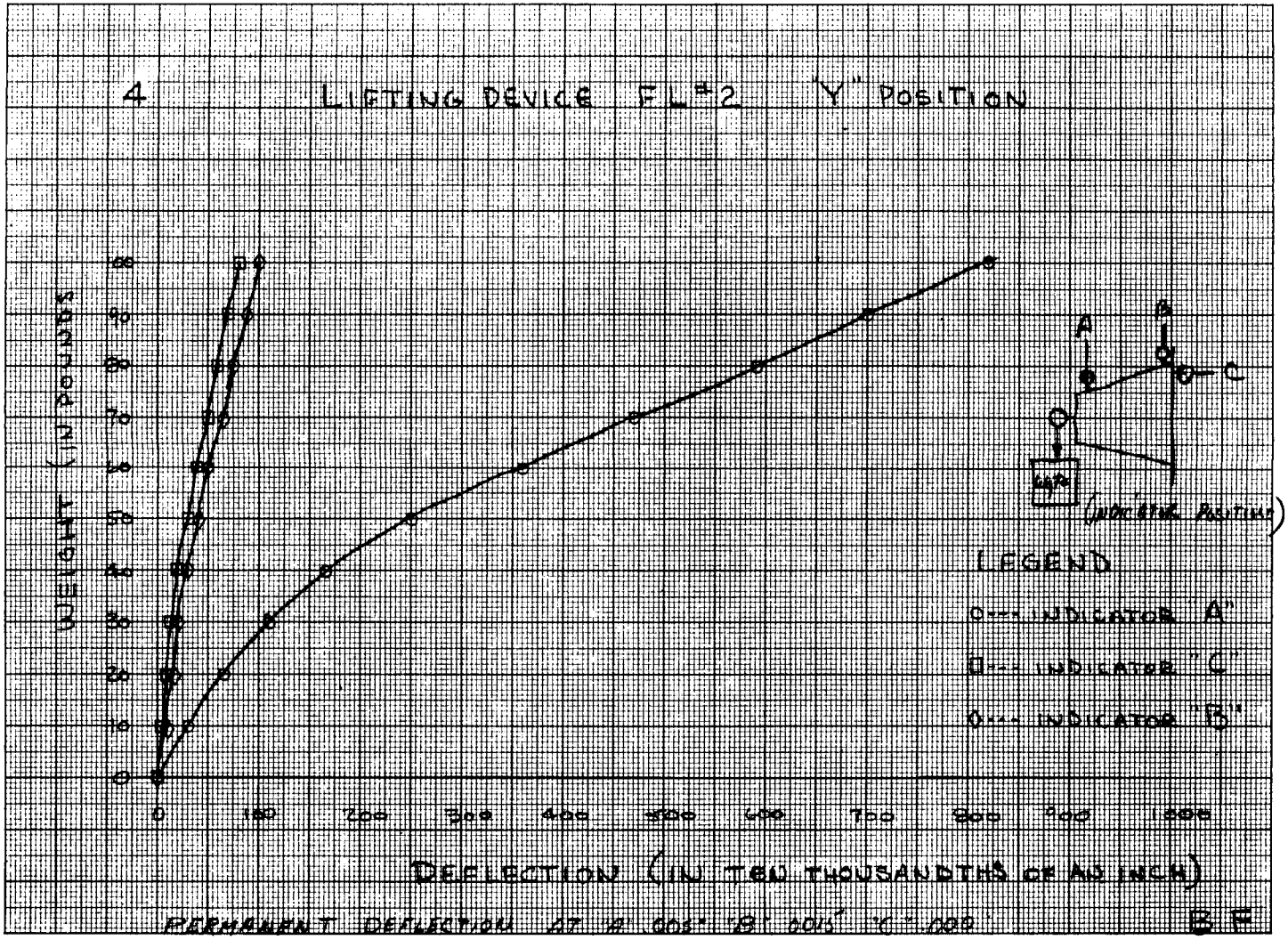
Specimens meet requirements set forth for lifting and hoisting S-51 (UK-1) satellite. The amount of permanent set indicated is deemed negligible.



1
LIFTING DEVICE FL #1 "X" POSITION
(INDICATOR POSITION)
LEGEND
INDICATOR "A"
INDICATOR "C"
INDICATOR "B"
WEIGHT (IN POUNDS)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000
DEFLECTION (IN TEN THOUSANDTHS OF AN INCH)
PERMANENT DEFLECTION AT "A" .004, "B" .001, "C" .001
BF


2
LIFTING DEVICE FL#1 'Y' POSITION
C
(INDICATOR POSITION)
WEIGHT (IN POUNDS)
LEGEND
INDICATOR 'A'
INDICATOR 'C'
INDICATOR 'B'
DEFLECTION (IN TEN THOUSANDTHS OF AN INCH)
PERMANENT DEFLECTION AT "A" .010 "B" .002 "C" 0
BF

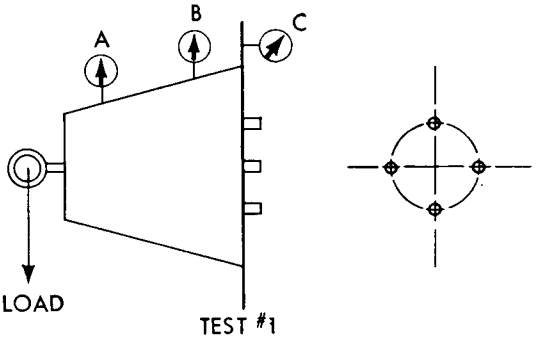

3
LIFTING DEVICE F-L # 2
"X" POSITION
WEIGHT (in Pounds)
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200
DEFLECTION (IN TEN THOUSANDTHS OF AN INCH)
PERMANENT DEFLECTION AT "A" .005 "B" .001 "C" 0
A
B
C
INDICATOR POSITION
LEGEND
INDICATOR "A"
INDICATOR "C"
INDICATOR "B"


4 LIFTING DEVICE FL-2 "Y" POSITION
WEIGHT (IN POUNDS)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000
DEFLECTION (IN TEN THOUSANDTHS OF AN INCH)
PERMANENT DEFLECTION AT "A" .005" "B" .004" "C" .002"
A
B
C
(INDICATOR POSITIONS)
LEGEND
O--- INDICATOR "A"
□--- INDICATOR "C"
◇--- INDICATOR "B"
B F

LIFTING DEVICE FL NO. 1

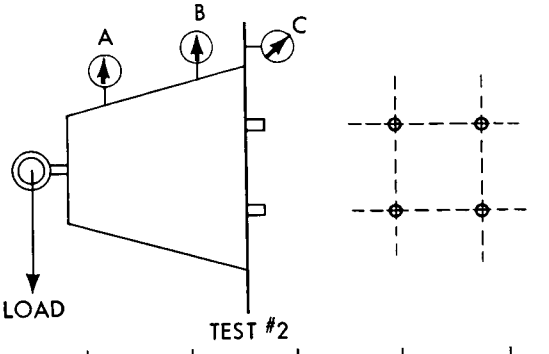
"X" POSITION

	INDICATORS		
Load	A	B	C
pounds		inches	
0	.000	.000	.000
10	.016	.0005	.0025
20	.028	.002	.005
30	.038	.003	.008
40	.048	.004	.011
50	.057	.005	.0135
60	.067	.0065	.0165
70	.077	.008	.019
80	.088	.0095	.022
90	.0975	.010	.025
100	.1075	.0115	.0275
	PERMANENT SET		
	.004	.001	.001



"Y" POSITION

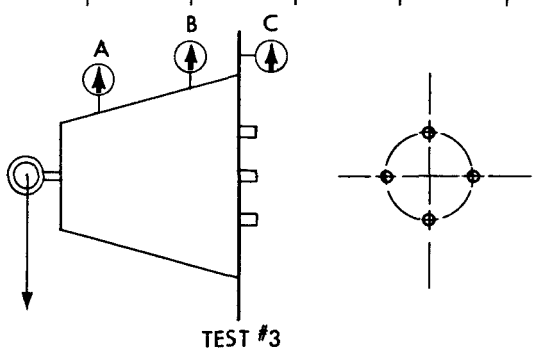
Load	A	B	C
0	.000	.000	.000
10	.011	.002	.000
20	.019	.003	.0005
30	.028	.0035	.001
40	.036	.0045	.0015
50	.045	.005	.0025
60	.054	.0065	.003
70	.061	.007	.004
80	.067	.0085	.0045
90	0.073	.0095	.005
100	.079	.011	.005
	PERMANENT SET		
	.010	.002	.000



LIFTING DEVICE FL NO. 2

"X" POSITION

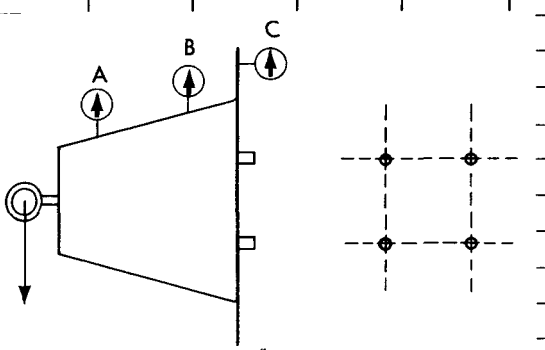
Load	INDICATORS A	B	C
pounds		inches	
0	.000	.000	.000
10	.019	.001	.004
20	.037	.0025	.009
30	.053	.004	.013
40	.063	.006	.016
50	.073	.007	.0185
60	.083	.0085	.021
70	.092	.010	.024
80	.101	.011	.026
90	.110	.012	.029
100	.120	.013	.031
	PERMANENT SET		
	.005	.001	.000



TEST #3

"Y" POSITION

Load	A	B	C
0	.000	.000	.000
10	.003	.001	.005
20	.0065	.0015	.001
30	.011	.002	.0015
40	.0165	.003	.002
50	.025	.004	.003
60	.036	.005	.004
70	.047	.0065	.005
80	.059	.0075	.006
90	.070	.009	.007
100	.082	.010	.008
	PERMANENT SET		
	.005	.0015	.000



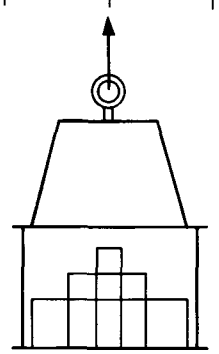
TEST #4

F. U. #1

TEST 5

AXIAL LOAD

450# Raised 12"



F. U. #2

TEST 6

AXIAL LOAD

450# Raised 12"

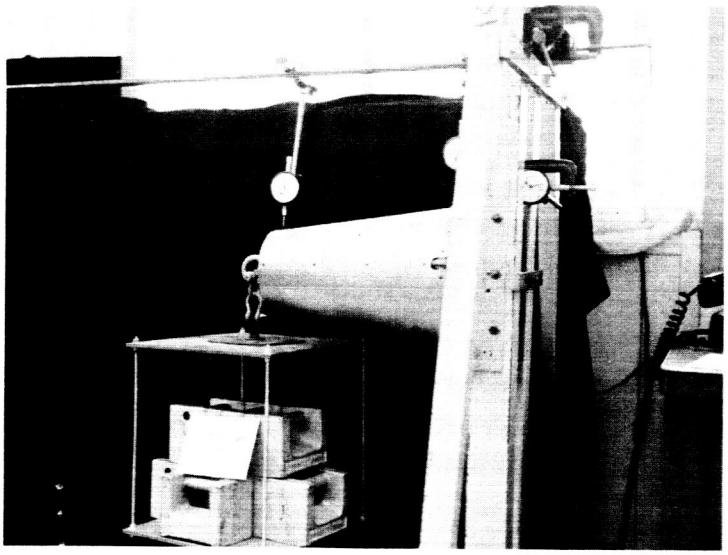


Photo No. 1–Cantilever Load

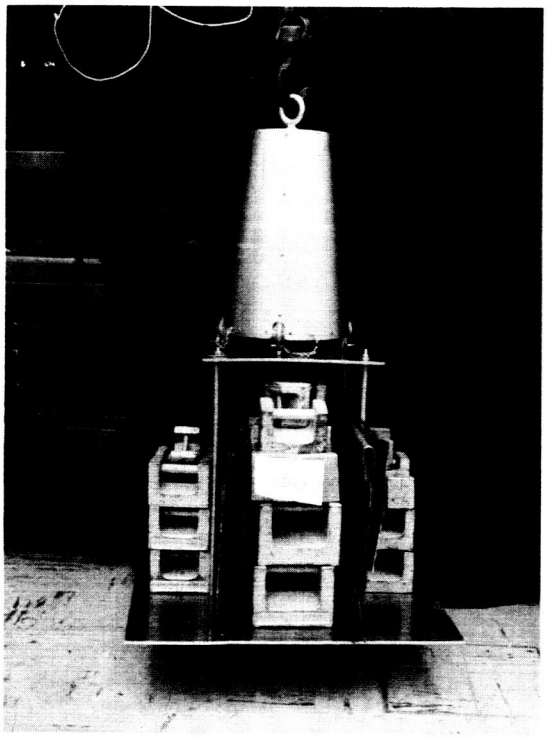


Photo No. 2–Axial Load

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-19

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Qualification of Hoist Handling Fixture

Date of Test: 1 Dec. '61

Requested by: Carl Wagner

Performed by: Tony Pierro & John Sween

Purpose of Test: To determine if fixtures would meet requirements.

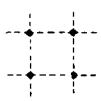
Description of Article Tested (Photographs, if any):

Frustrum of a cone, 18" high, 8" diam. at base, 3/4" O.D. tubing welded assembly. 1/2" eye bolt at top & 4-3/16" alum. shear pin clevis bolt assy. at bottom.

Test Equipment (Photographs, if any):

1. Chain Fall
2. A-Frame
3. Dial Indicators
4. Test Fixture for Cantilever
5. Weight Pan
6. 450# F&M Weights

Test Procedure:

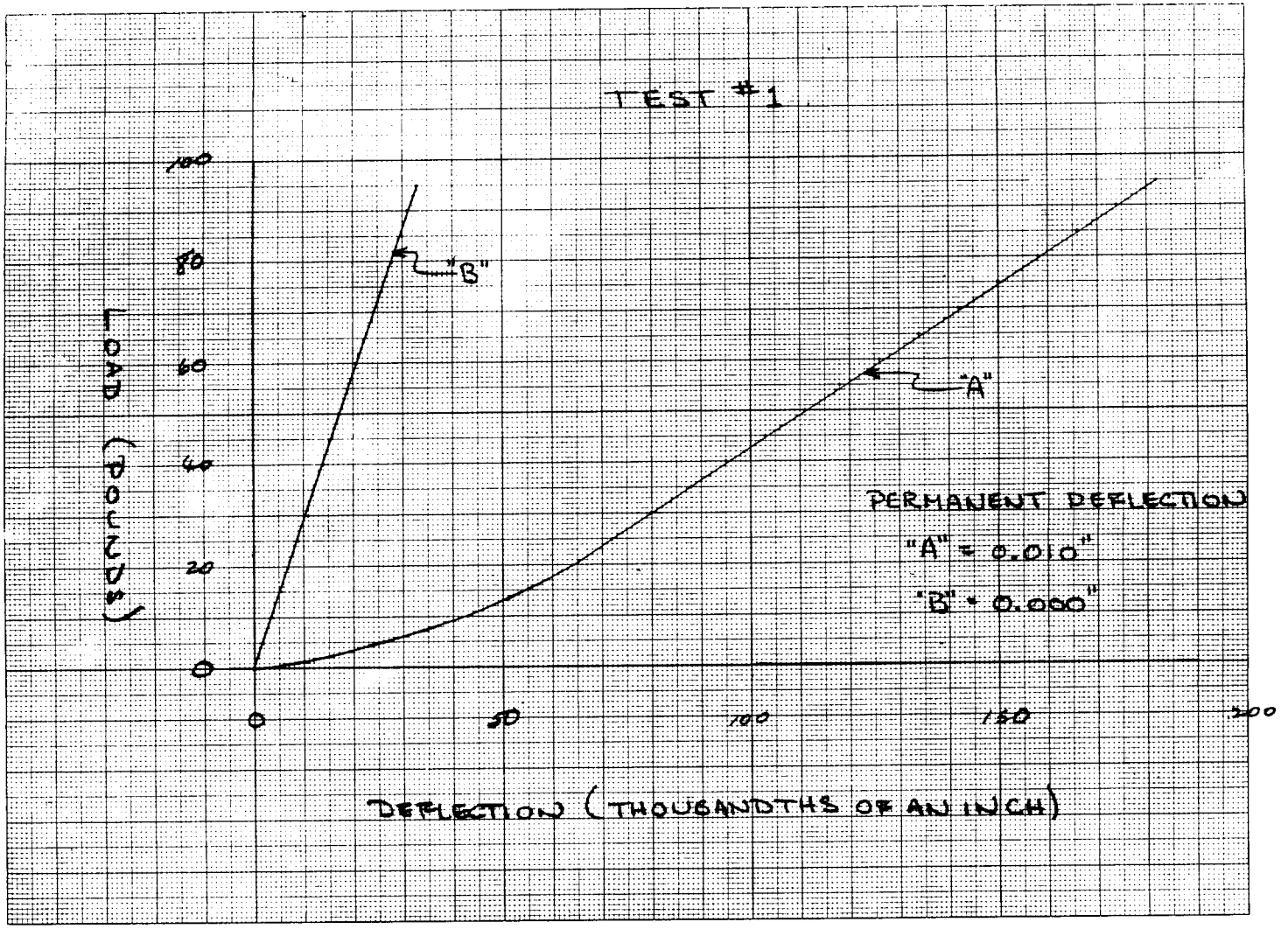
1. Tests #1, 2, 3, had lugs in base arranged 
2. Tests #4, 5, 6, had lugs in base arranged 
3. Tests #1 thru #6 were set-up as in Photo # 1.
4. Weights were added in 5# increments from 0-95#.
5. Deflection was read at each increment. See SK-1.
6. Tests 7, 8, 9, were axial loads of 450# simply raised 12" from floor by means of a chain fall. See Photo #2.

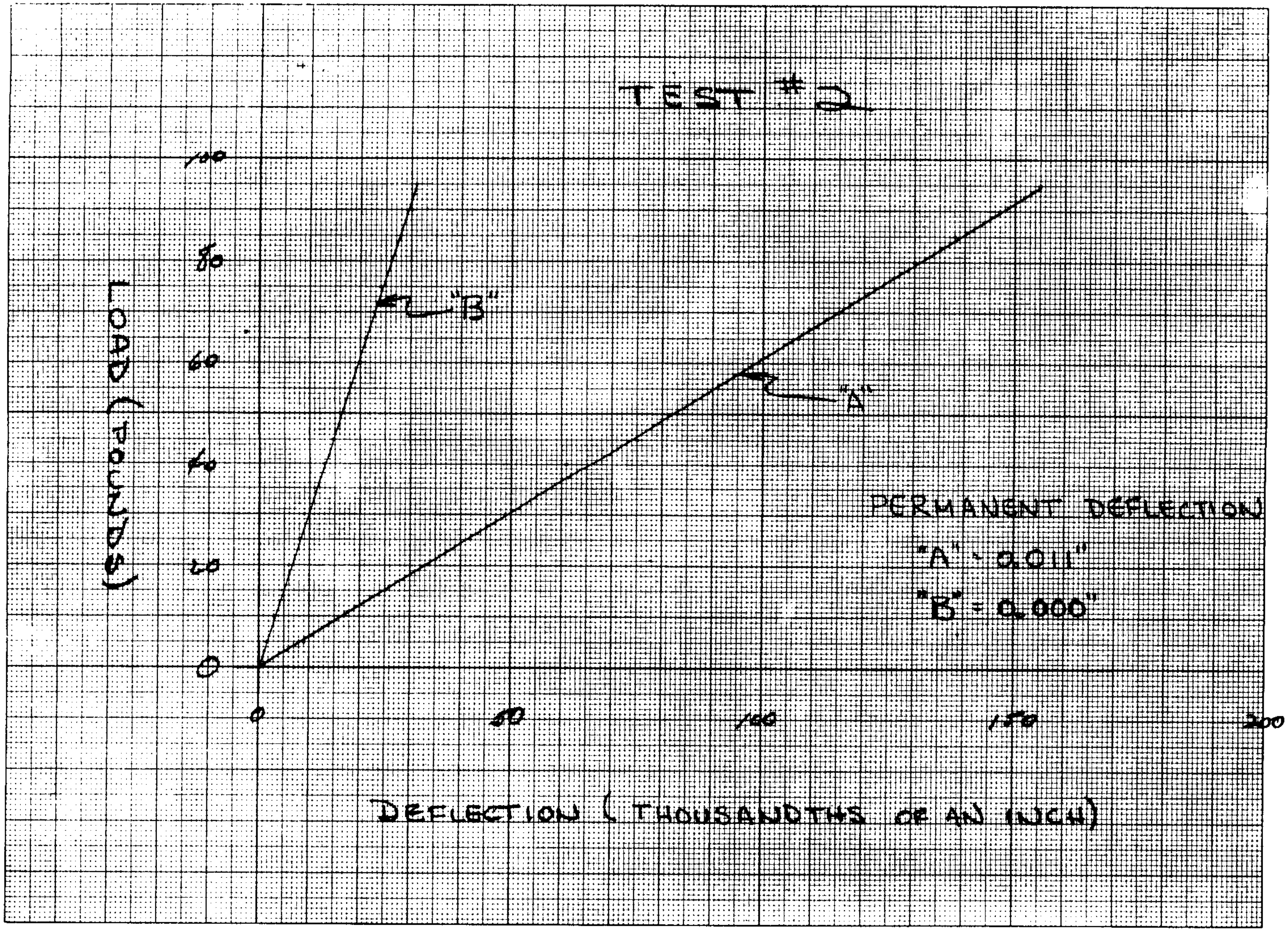
Results:

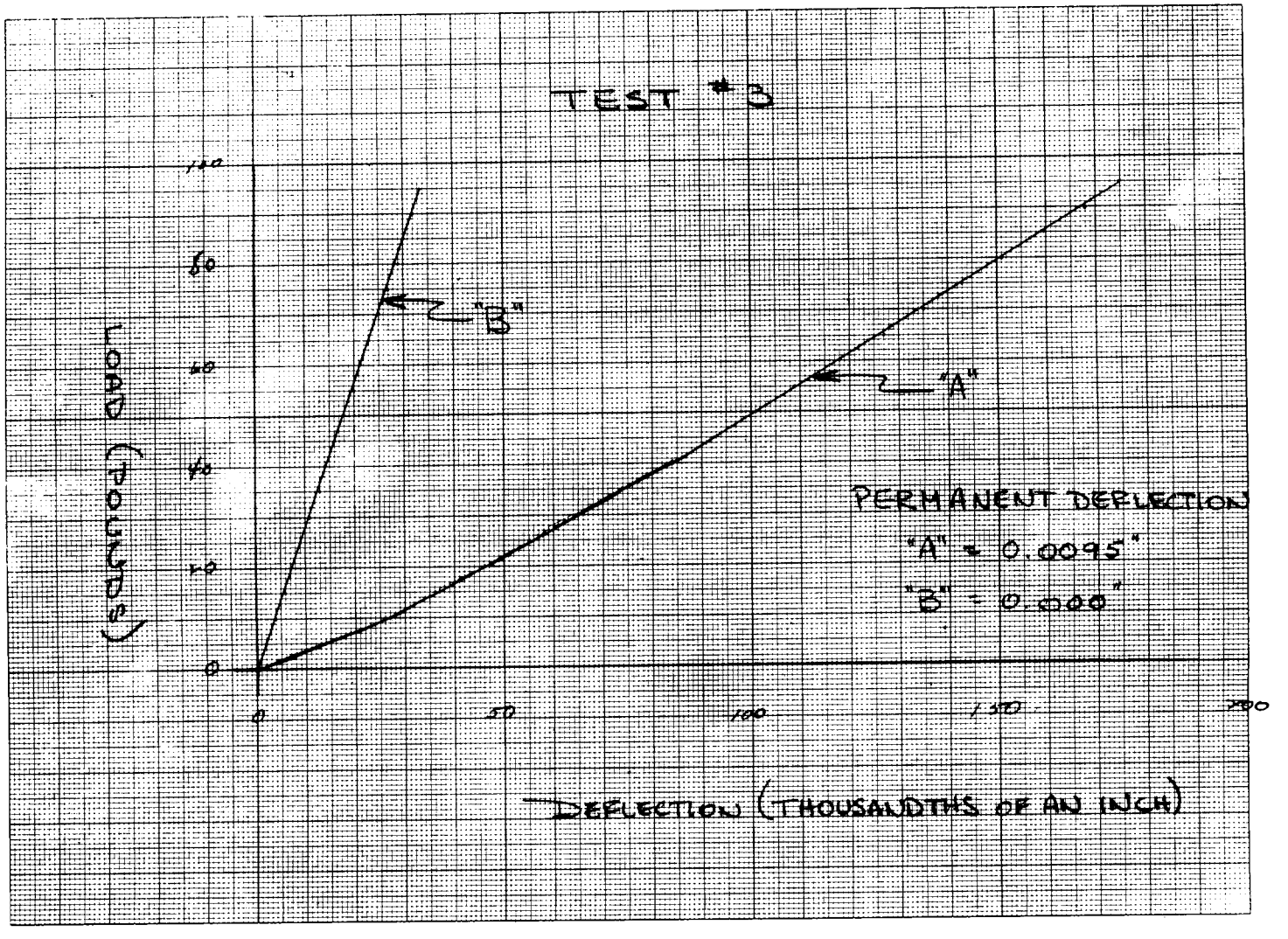
See Graphs & Data Sheets. No visible damage to specimens. Some permanent set was measured. AJP

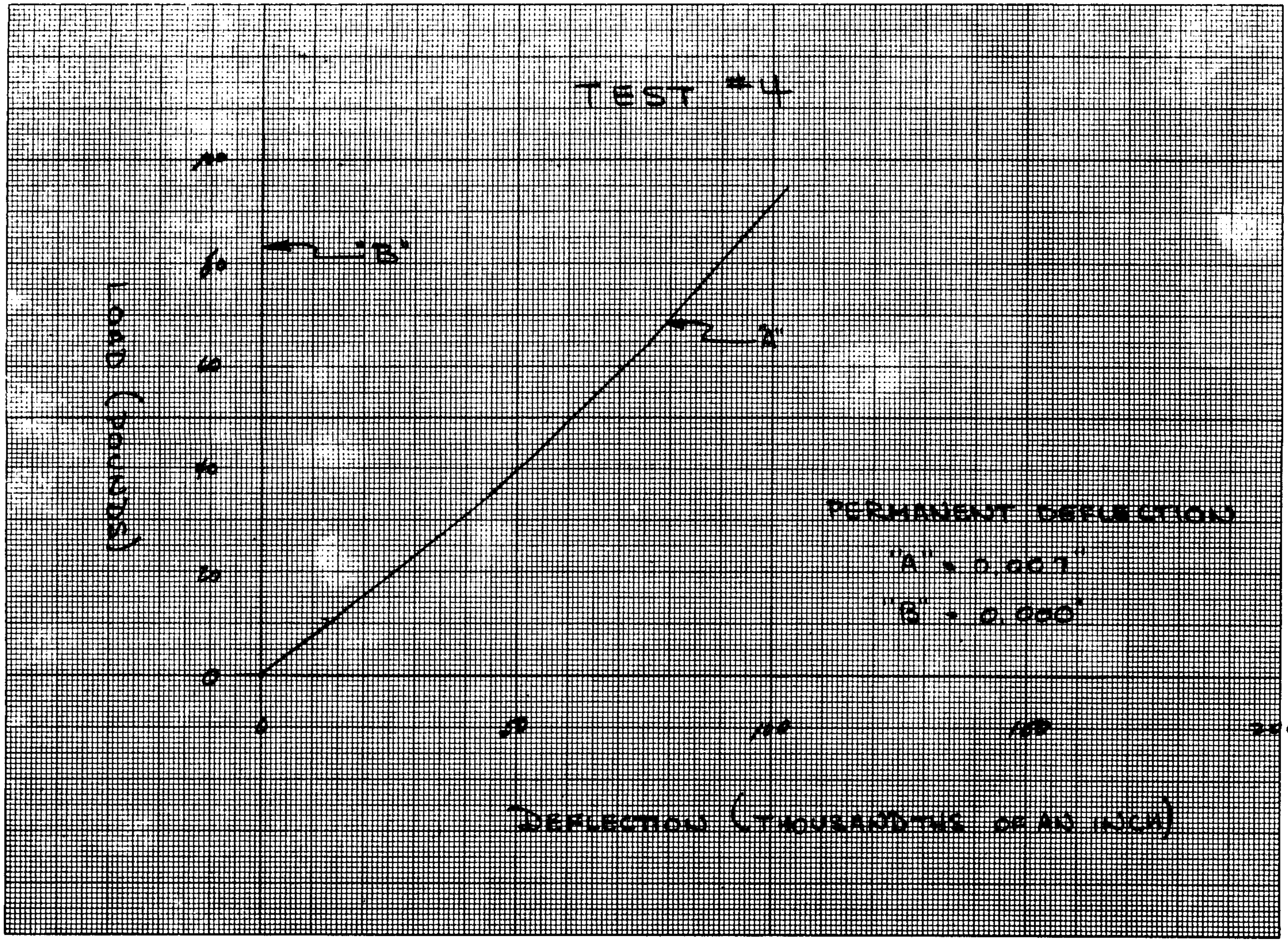
Conclusions:

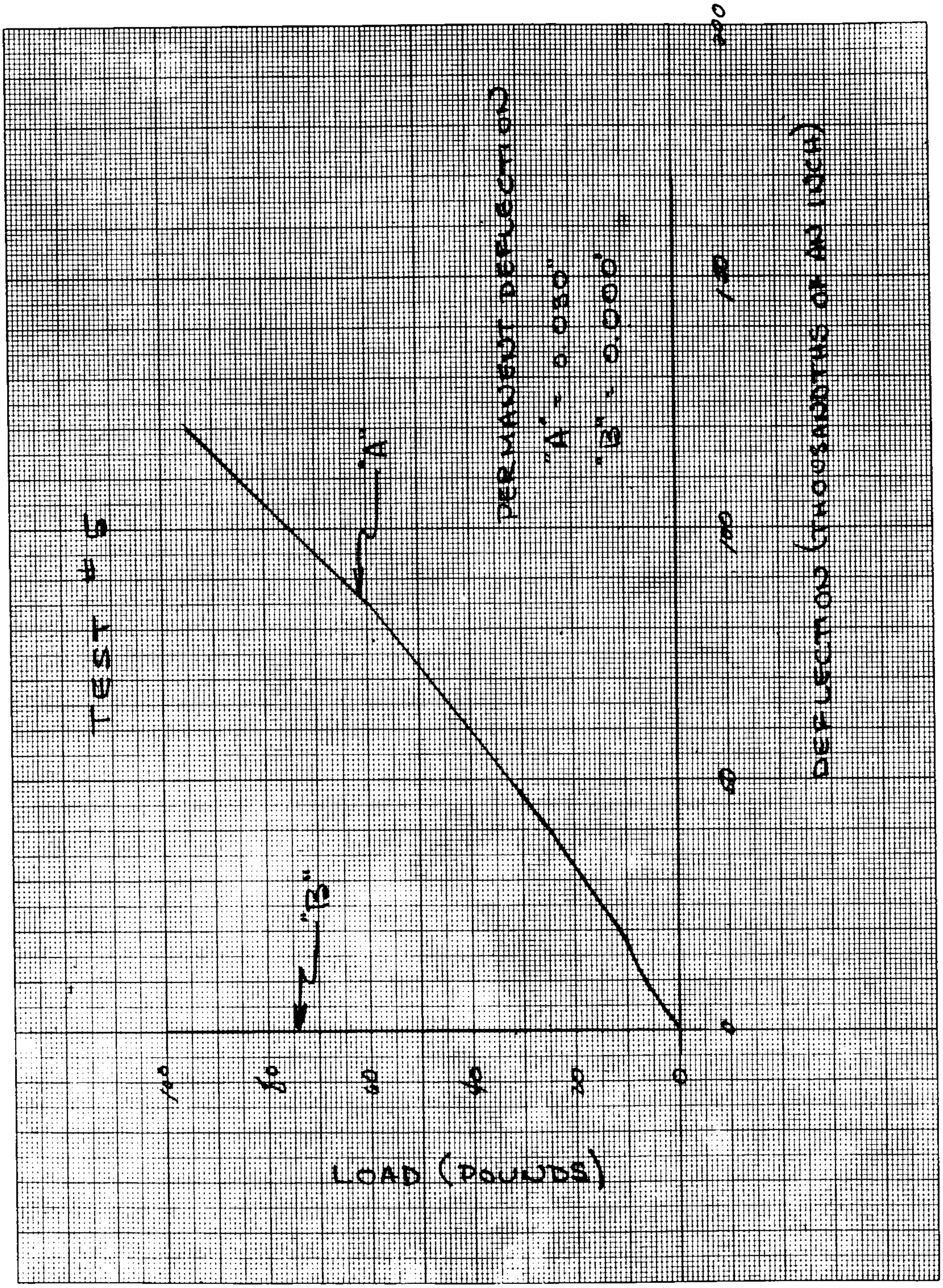
Hoist handling fixtures are released for use.

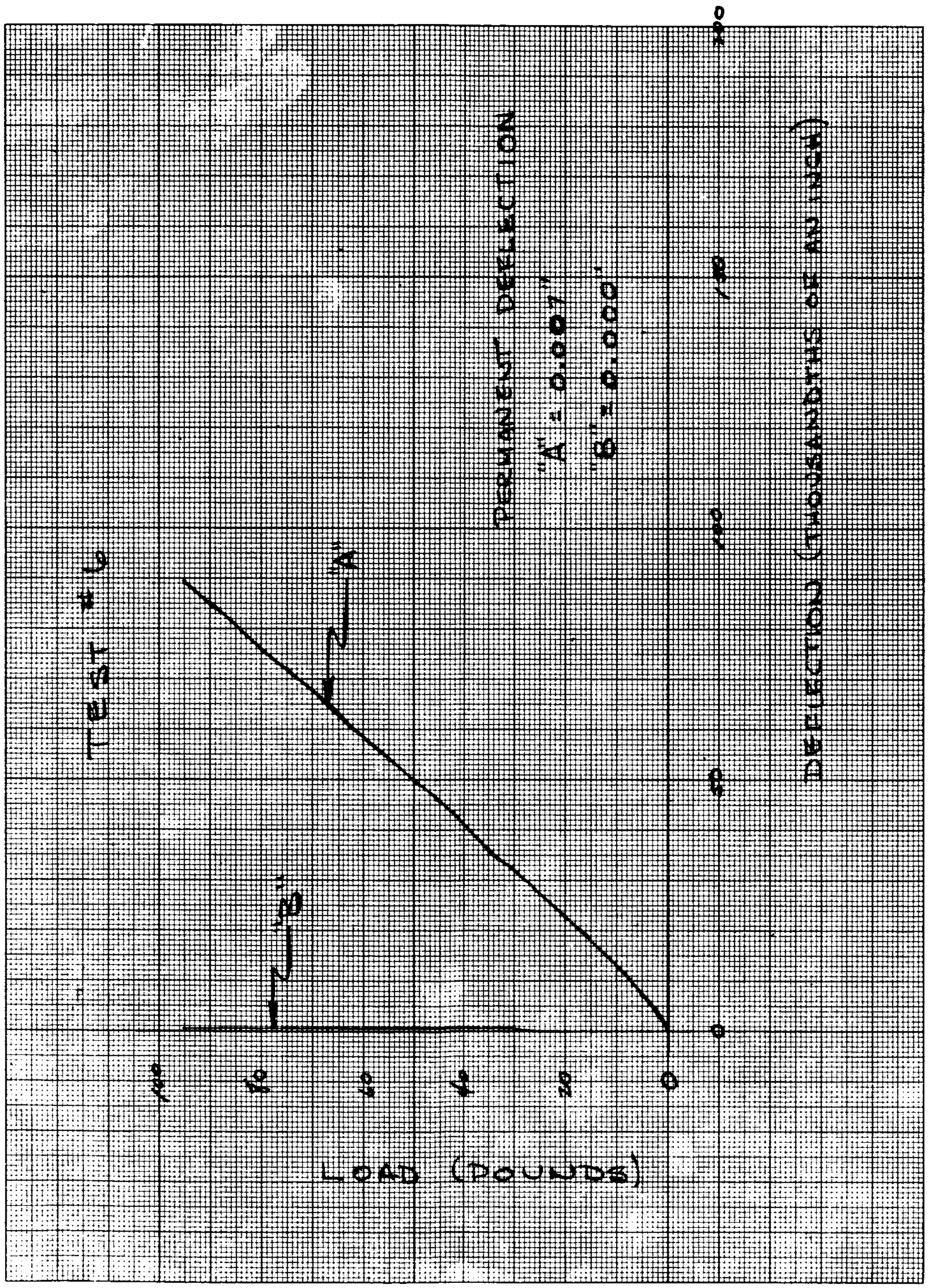

TEST #1
LOAD (POUNDS)
100
80
60
40
20
0
"B"
"A"
PERMANENT DEFLECTION
"A" = 0.010"
"B" = 0.000"
0
50
100
150
200
DEFLECTION (THOUSANDTHS OF AN INCH)


TEST #2
LOAD (POUNDS)
100
80
60
40
20
0
0
50
100
150
200
DEFLECTION (THOUSANDTHS OF AN INCH)
"A"
"B"
PERMANENT DEFLECTION
"A" - 0.011"
"B" = 0.000"


TEST # 3
LOAD (POUNDS)
100
80
60
40
20
0
0
50
100
150
200
"B"
"A"
PERMANENT DEFLECTION
"A" = 0.0095"
"B" = 0.000"
DEFLECTION (THOUSANDTHS OF AN INCH)


TEST #4
LOAD (POUNDS)
DEFLECTION (THOUSANDTHS OF AN INCH)
"B"
"A"
PERMANENT DEFLECTION
"A" = 0.007"
"B" = 0.000"
0
20
40
60
80
100
0
50
100
150
200

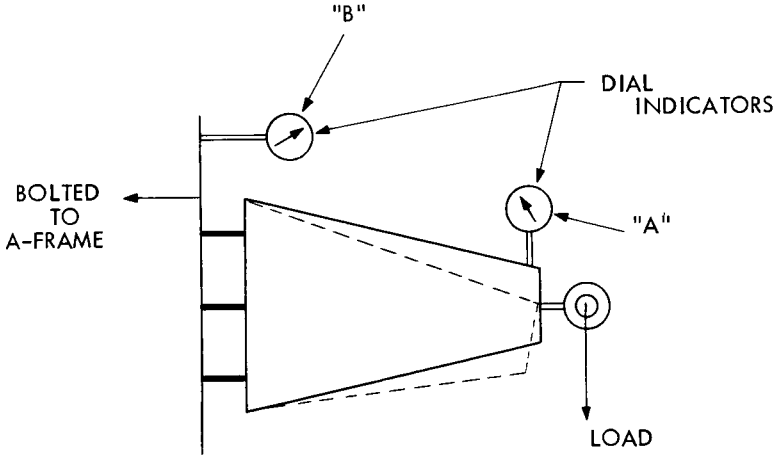

TEST #5
PERMANENT DEFLECTION
"A" = 0.030"
"B" = 0.000"
"A"
"B"
LOAD (POUNDS)
DEFLECTION (THOUSANDTHS OF AN INCH)
0
20
40
60
80
100
0
50
100
150
200


TEST # 6
PERMANENT DEFLECTION
"A" = 0.007"
"B" = 0.000"
"A"
"B"
DEFLECTION (THOUSANDTHS OF AN INCH)
0
50
100
150
200
LOAD (POUNDS)
0
20
40
60
80
100

TEST NO. 1				TEST NO. 2				TEST NO. 3		
Load	"A"	"B"		Load	"A"	"B"		Load	"A"	"B"
0	.000	.000		0	.000	.000		0	.000	.000
5	.026	.0015		5	.009	.0015		5	.013	.002
10	.043	.0035		10	.017	.003		10	.026	.004
15	.055	.0055		15	.025	.0045		15	.037	.006
20	.064	.007		20	.033	.006		20	.046	.007
25	.072	.009		25	.042	.008		25	.055	.009
30	.080	.011		30	.049	.009		30	.065	.011
35	.088	.012		35	.058	.011		35	.074	.013
40	.095	.014		40	.061	.013		40	.084	.014
45	.103	.0155		45	.075	.0145		45	.0925	.016
50	.111	.0175		50	.083	.016		50	.101	.018
55	.118	.019		55	.091	.018		55	.109	.020
60	.126	.0205		60	.099	.020		60	.118	.0215
65	.134	.0225		65	.107	.021		65	.127	.023
70	.142	.024		70	.115	.0225		70	.135	.025
75	.150	.026		75	.122	.024		75	.143	.027
80	.158	.028		80	.130	.026		80	.151	.029
85	.166	.030		85	.138	.028		85	.1595	.030
90	.174	.031		90	.147	.030		90	.168	.032
95	.182	.033		95	.155	.031		95	.175	.0335
0	.010	.000		0	.011	.000		0	.0095	.000

TEST NO. 4				TEST NO. 5				TEST NO. 6		
Load	"A"	"B"		Load	"A"	"B"		Load	"A"	"B"
0	.000	.000		0	.000	.000		0	.000	.000
5	.0065	.000		5	.0075	.000		5	.007	.000
10	.0135	.000		10	.018	.000		10	.013	.000
15	.020	.000		15	.025	.000		15	.018	.000
20	.026	.000		20	.033	.000		20	.023	.000
25	.032	.000		25	.040	.000		25	.027	.000
30	.039	.000		30	.047	.000		30	.032	.0005
35	.045	.000		35	.054	.000		35	.036	.0005
40	.050	.000		40	.060	.000		40	.041	.0005
45	.056	.000		45	.066	.000		45	.0455	.0005
50	.060	.000		50	.073	.000		50	.050	.0005
55	.065	.000		55	.079	.000		55	.054	.0005
60	.070	.000		60	.085	.000		60	.058	.0005
65	.076	.000		65	.090	.000		65	.063	.0005
70	.0805	.000		70	.095	.000		70	.068	.0005
75	.086	.000		75	.100	.000		75	.072	.0005
80	.089	.000		80	.105	.000		80	.076	.0005
85	.094	.000		85	.1095	.000		85	.0805	.0005
90	.098	.000		90	.115	.000		90	.085	.0005
95	.103	.000		95	.120	.000		95	.0895	.0005
0	.007	.000		0	.030	.000		0	.007	.0000

SK-1



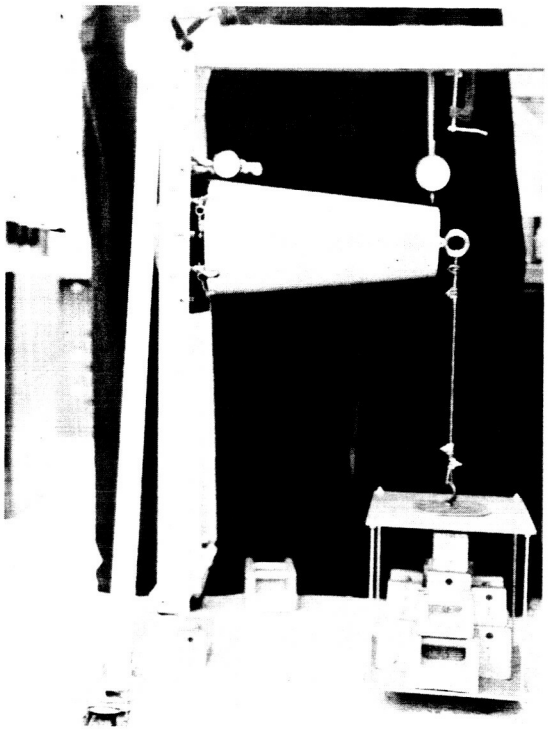


Photo No. 1–Cantilever

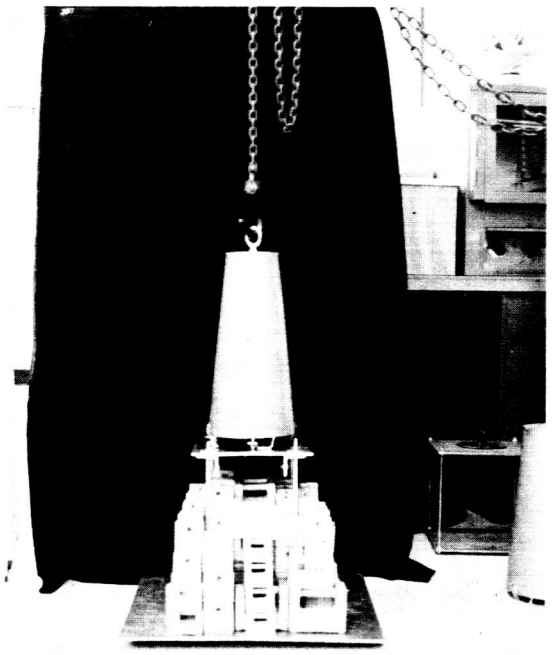


Photo No. 2–Axial

XI – MISCELLANEOUS

File No. 500-33

FNL	P.E.
FNL	S.H.
RCB	B.H.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

Name of Test: Density Determination – Eccofoam FPH

Date of Test: 8 Jan. '62

Requested by: F. N. LeDoux

Performed by: J. Sween & J. Kauffman

Purpose of Test: Density of two samples of Eccofoam FPH.

Description of Article Tested (Photographs, if any):

1. 9/16" × 11/16" × 1/8" Eccofoam FPH – Taken from converter
2. 3/4" × 15/16" × 1/8" Eccofoam FPH – Taken from tracking transmitter.

Specimens are on file.

Test Equipment (Photographs, if any):

1. Ainsworth Milligram Scale
2. Micrometer (.001)

Test Procedure:

1. Cut sample specimens from each block.
2. Find average length, width, & thickness of each sample.
3. Find weight of each sample.
4. Calculate density of each sample.

Results:

See Data Sheet.

Conclusions:

SHEET _____

	① FROM CONVERTER					② FROM TRACKING TRANSMITTER				
Weight		Length	Width	Thick.		Weight		Length	Width	Thick.
0.2895g		0.685	0.566	0.155		0.5516g		0.943	0.751	0.136
		0.683	0.570	0.156				0.945	0.748	0.134
		0.676	0.571	0.154				0.943	0.749	0.137
		0.681	0.568					0.946	0.747	0.133
	Average	0.681	0.569	0.155			Average	0.944	0.749	0.135
	Volume	0.0600	$in.^3$				Volume	0.0955	$in.^3$	
①	DENSITY = 18.38 #/FT^3					②	DENSITY = 22.00 #/FT^3			

DATA PAPER (11 COLUMN) PRNC-GEN-KK (REV. 9-53)

NAVY-BPPO PRNC, WASH., D.C.

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-26

CEV	P.E.
HE	S.H.
RCB	B.H.

Name of Test: Heat Transfer of Teflon

Date of Test: 1 Feb. '62

Requested by: C. E. Vest

Performed by: Peterson & Sween

Purpose of Test: To determine heat transfer through a known thickness of Teflon at a known distance from a heat source.

Description of Article Tested (Photographs, if any):

Teflon Sheet 6"× 6" ×.020"

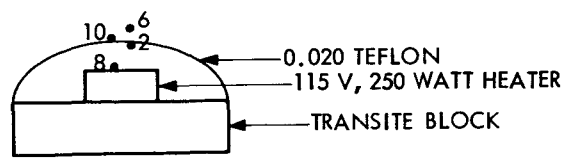
Test Equipment (Photographs, if any):

CVC Vacuum System
Minneapolis Millivolt Recorder
Ainsworth Balance.

Test Procedure:

1. Teflon was cleaned by placing in a detergent solution in the ultrasonic cleaner.
2. Weight was measured on Ainsworth Balance.
3. Teflon was secured to transite block so that a space of 1/2" between heater & Teflon was maintained.
4. The thermocouples were held against the Teflon by the spring tension of the thermocouple wire.

NOTE: Thermocouples were positioned so that the temperature of the heat source (#8) and the Teflon (#2) nearest the heat source, and the Teflon (#10) outside the heat source, and the space (#6) 1/4" from #10, were compared.



Results:

Weight of Teflon

Before	After	Change
26.6998g	26.7213g	+0.0215

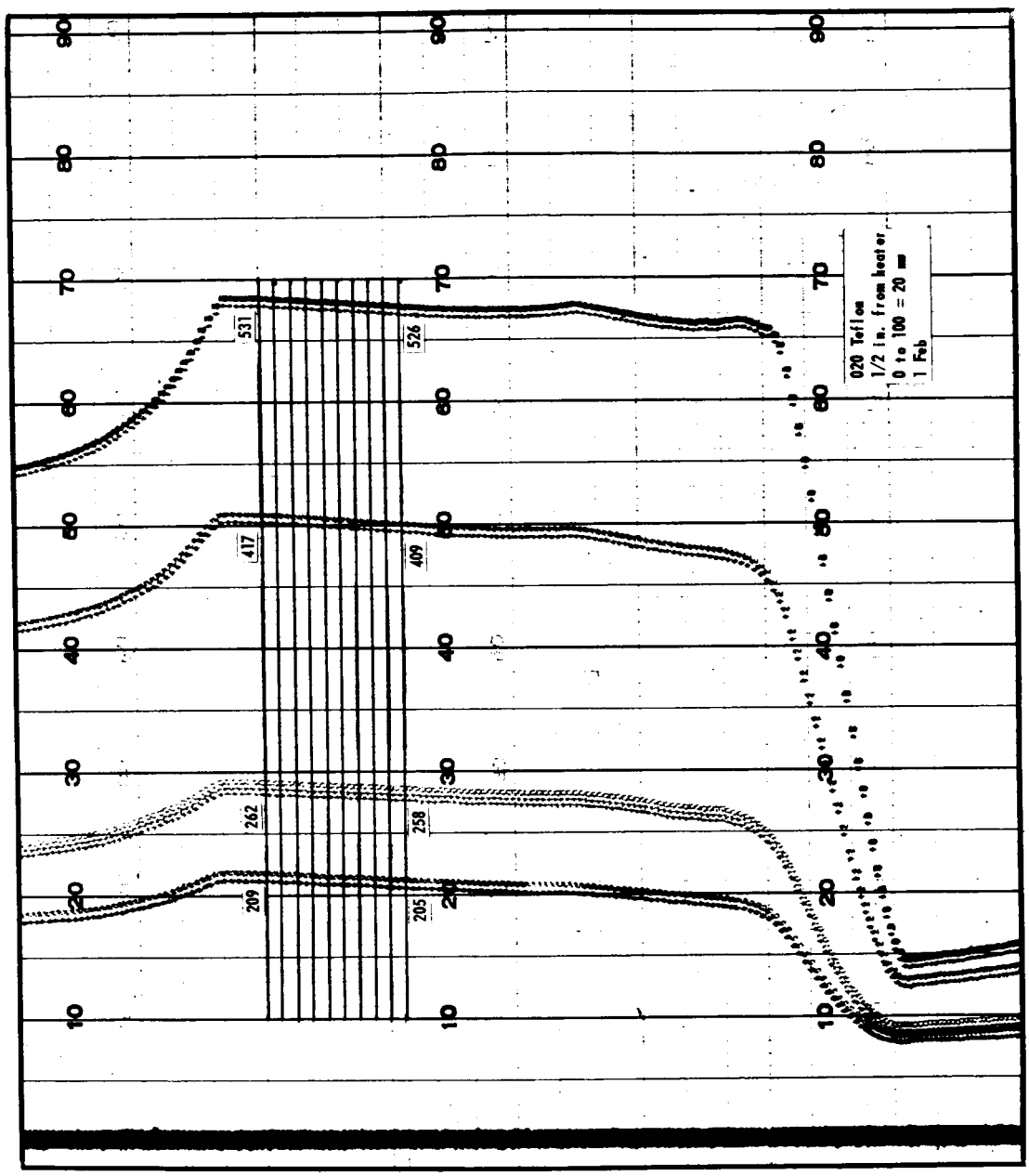
Graphs.

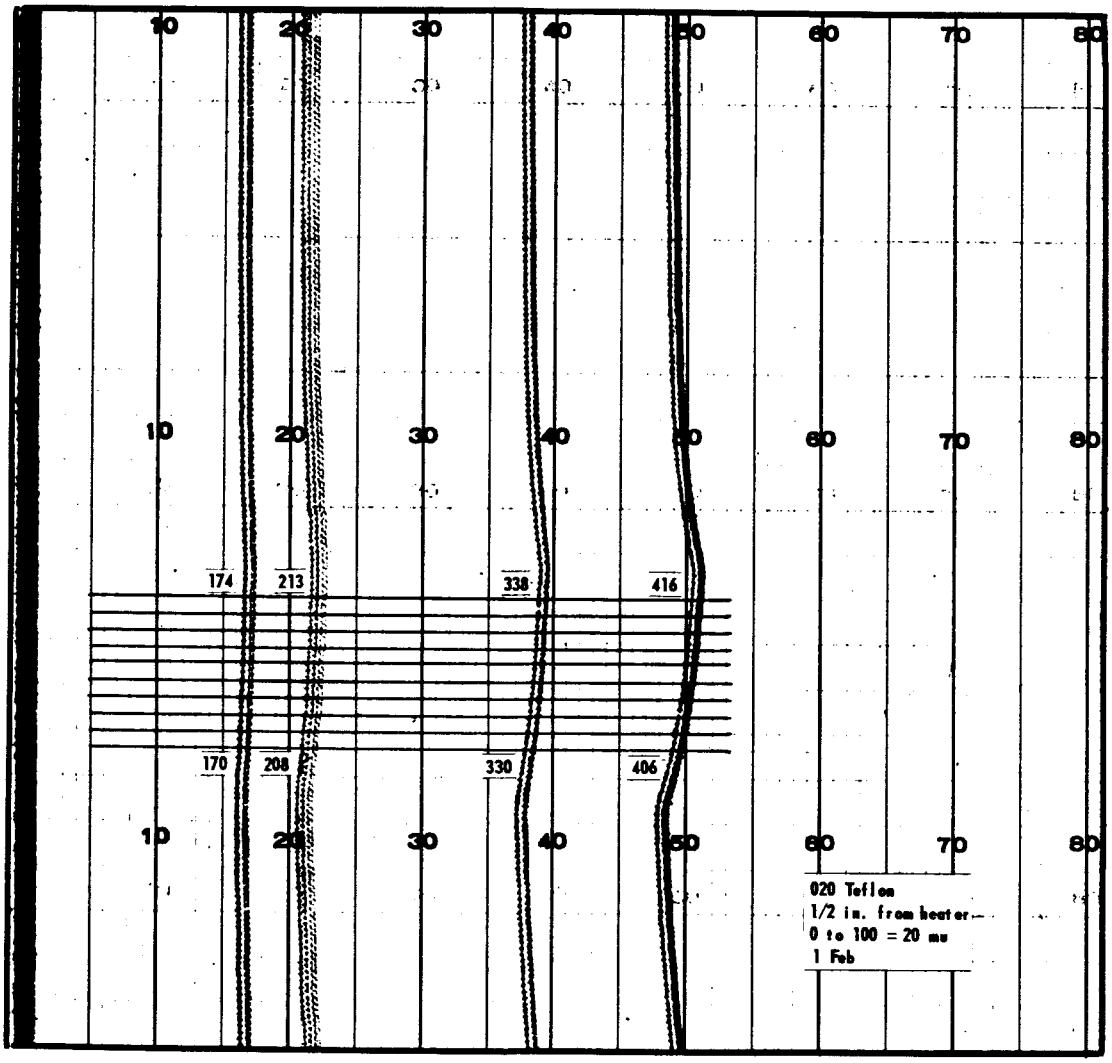
Conclusions:

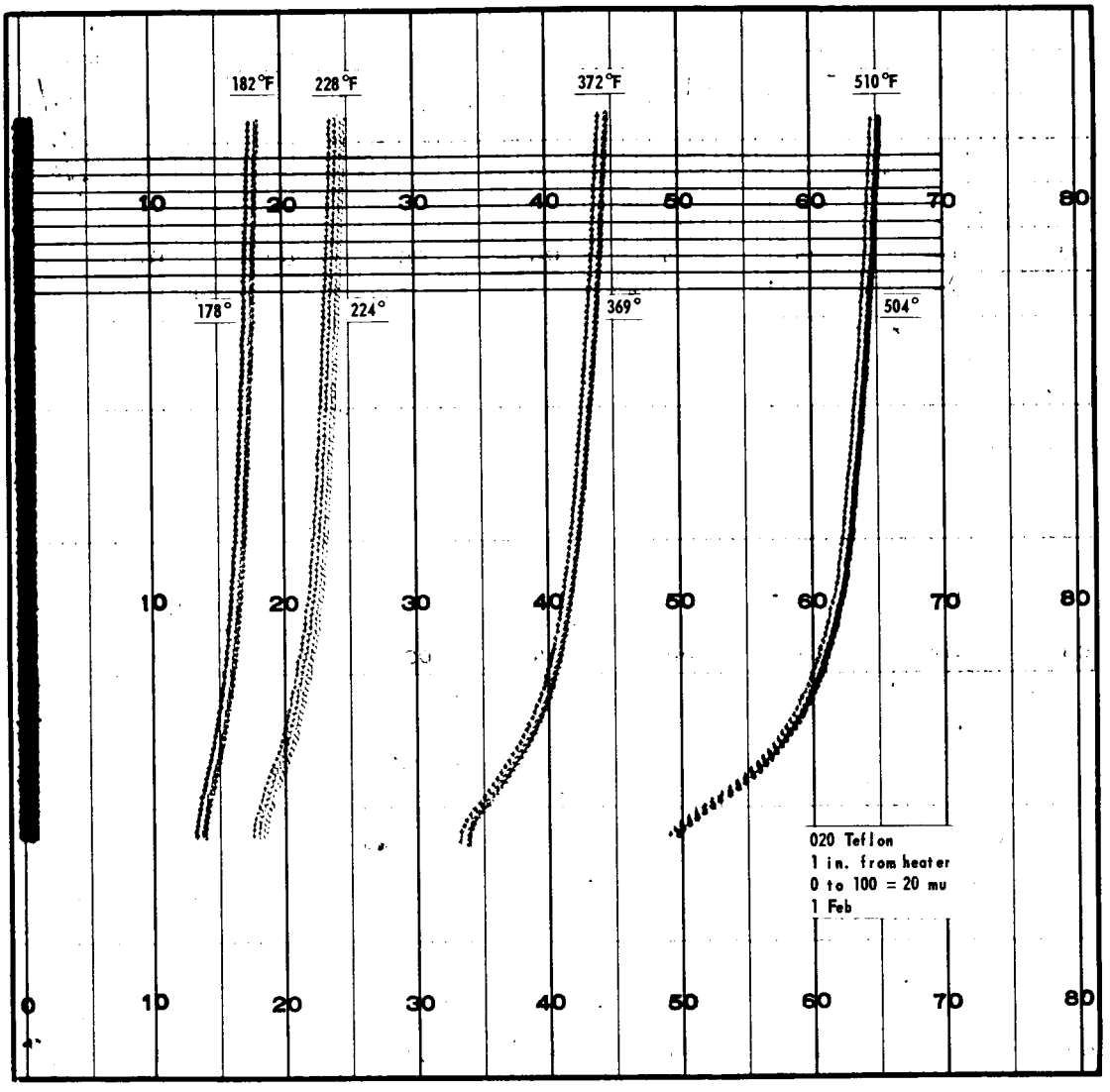
The results indicate that the temperature drop across the Teflon is sufficient to minimize outgassing contamination to the payload.

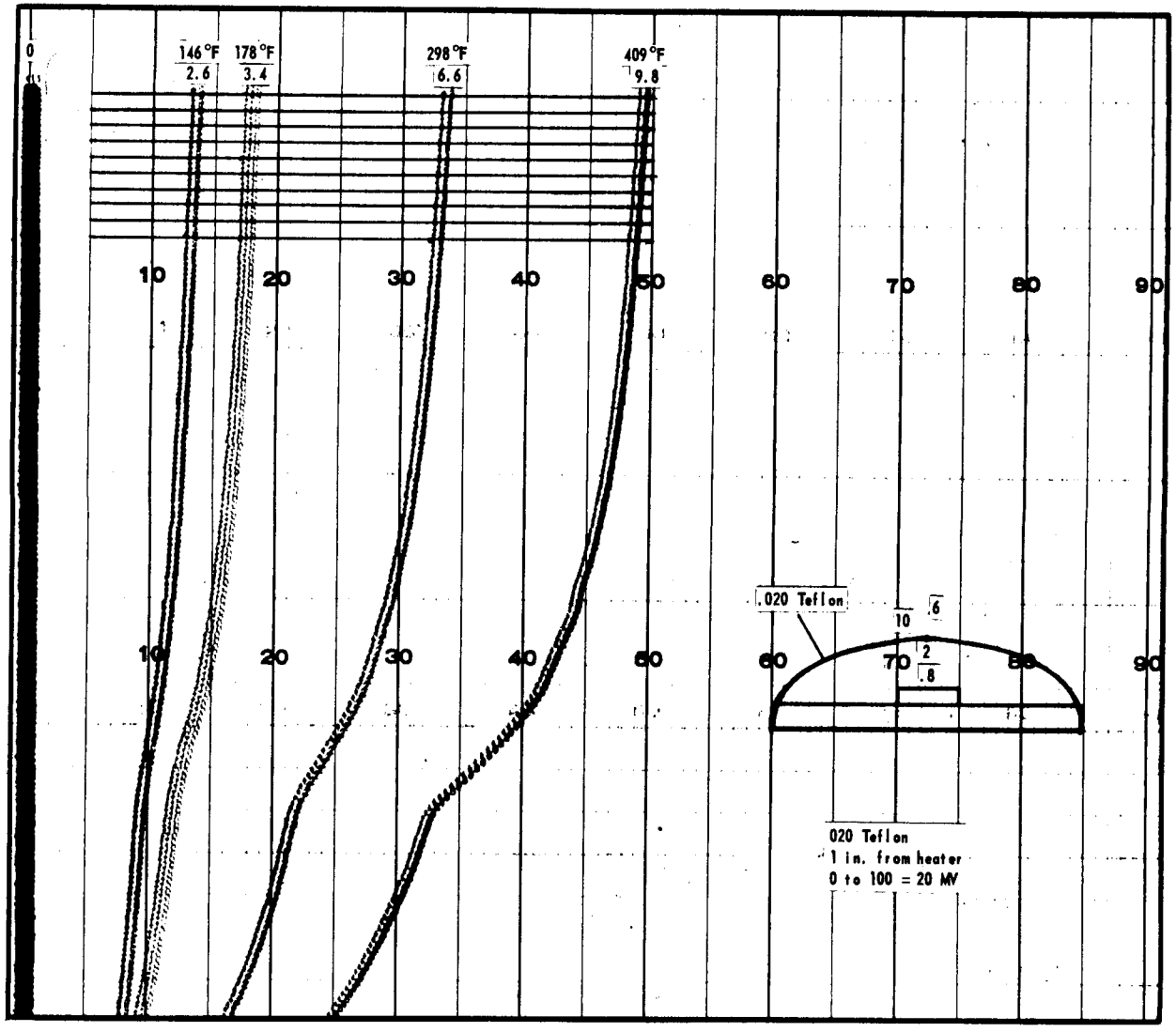
As a 0.010" Teflon sheet is available, the test will be run on it.

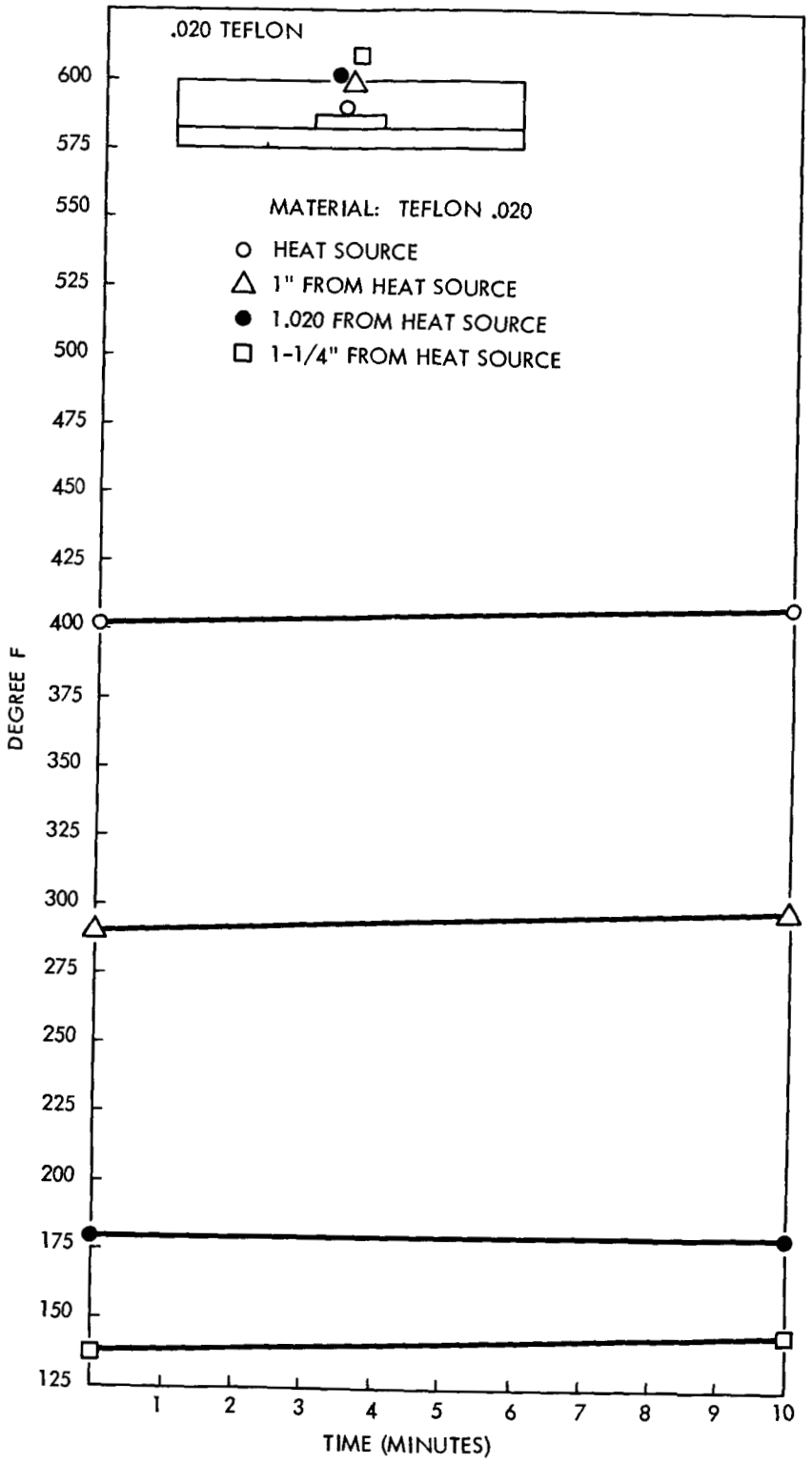
The weight gain shown (0.0215g) is of no concern to this test and it is probably a condensation of outgassed products from other components in the test.

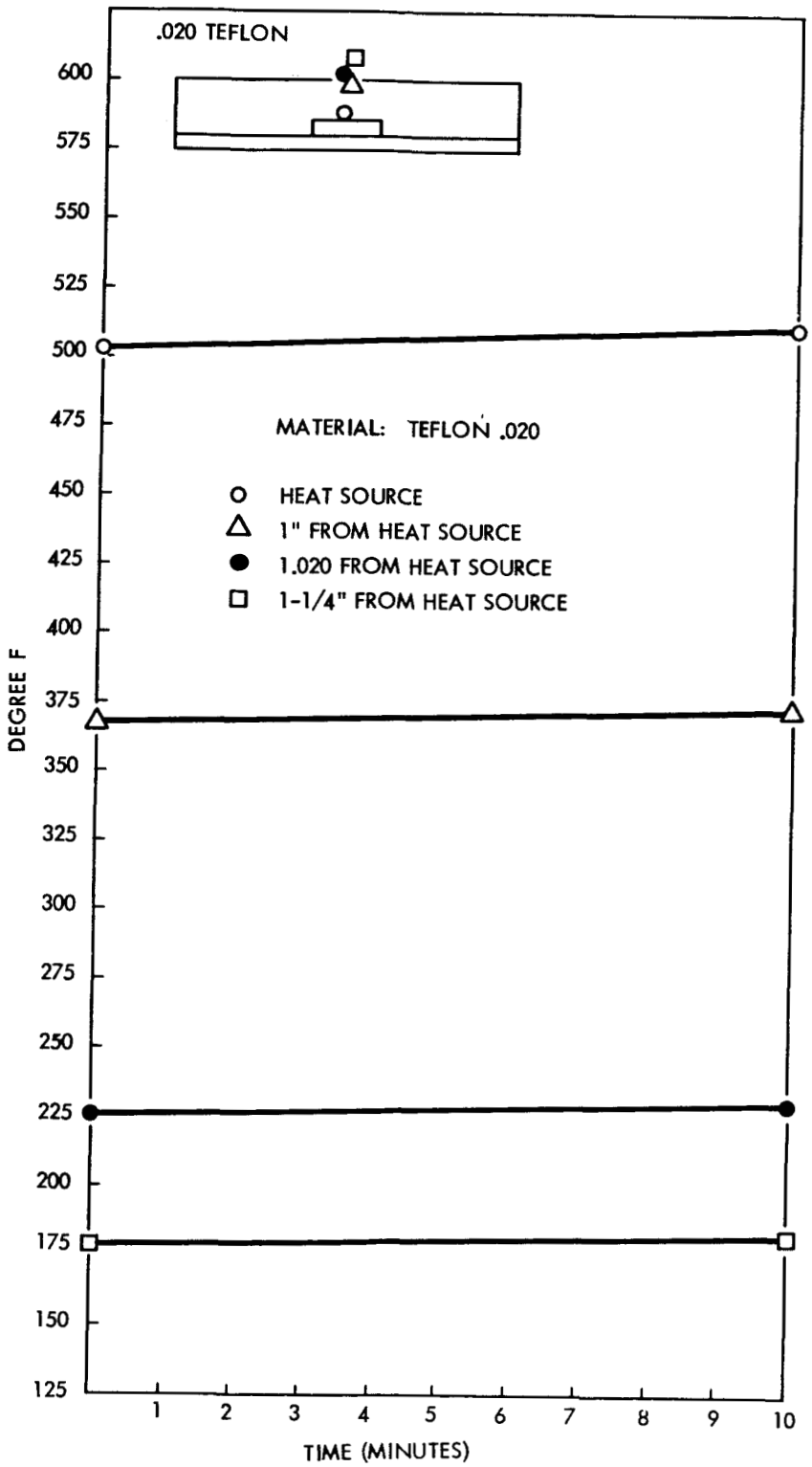

020 Teflon
1/2 in. from heater
0 to 100 = 20 mm
1 Feb
531
526
417
409
262
258
209
205

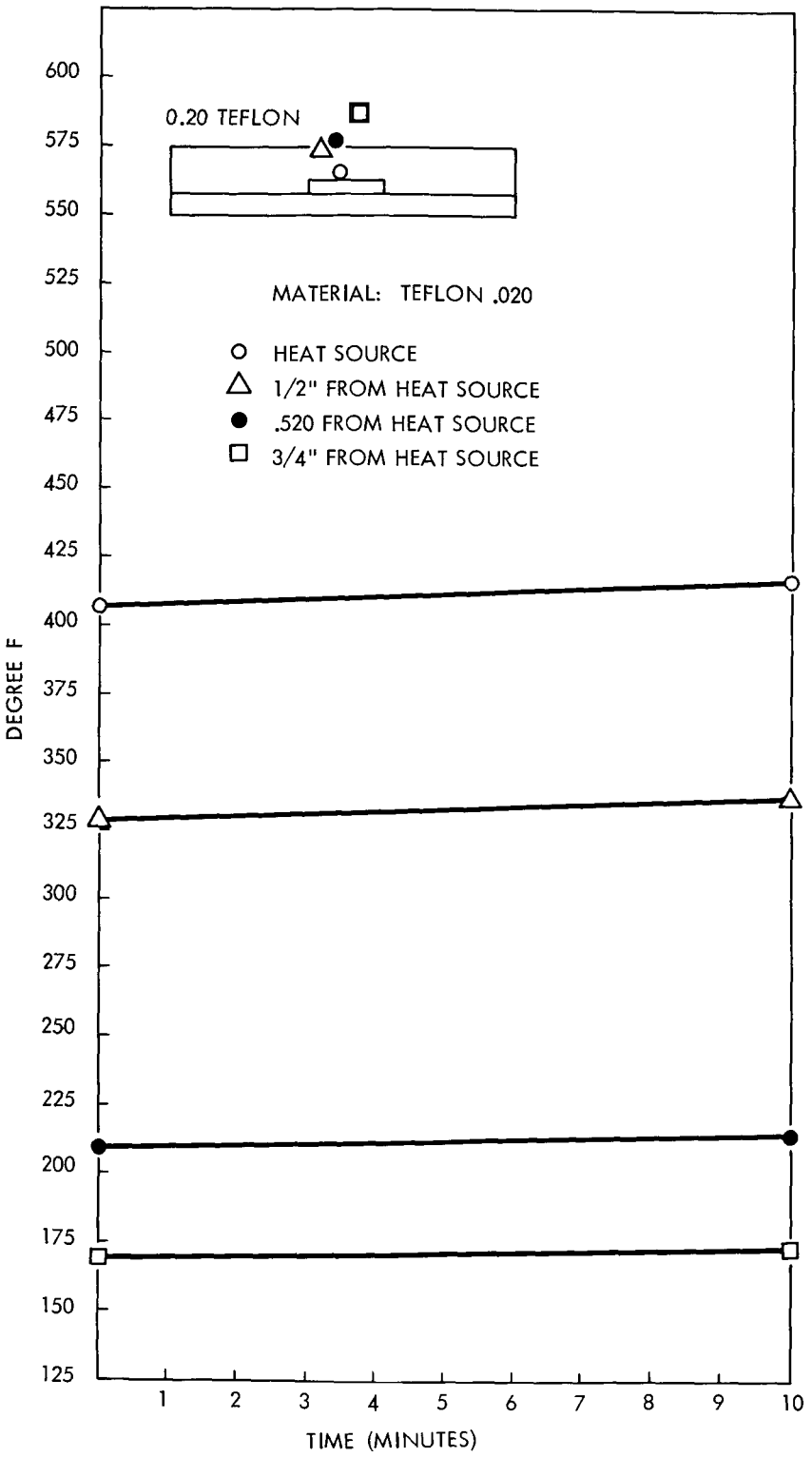

10
20
30
40
50
60
70
80
174
213
338
416
170
208
330
406
020 Teflon
1/2 in. from heater
0 to 100 = 20 mv
1 Feb

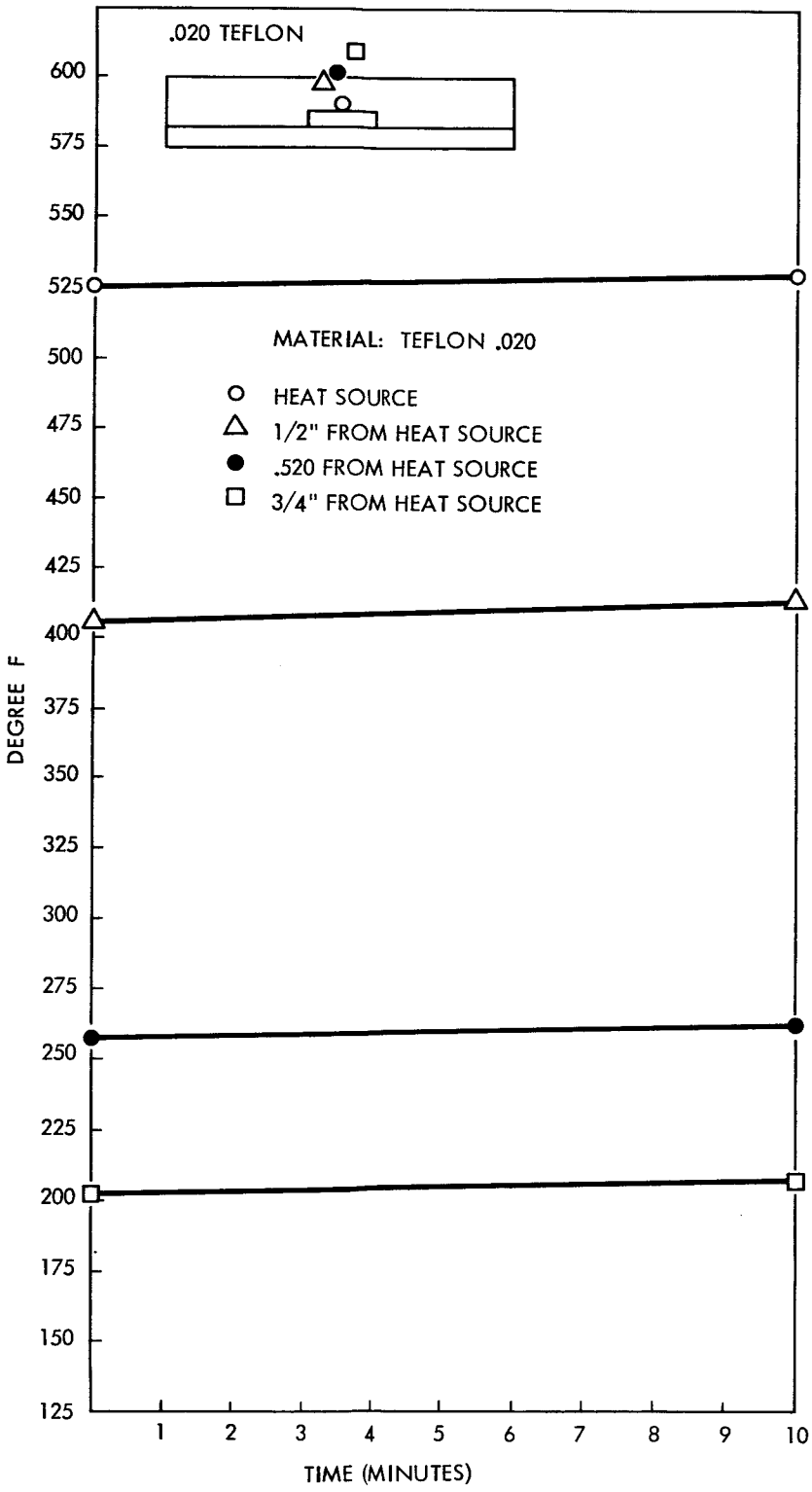

182°F
228°F
372°F
510°F
178°
224°
369°
504°
10
20
30
40
50
60
70
80
0
020 Teflon
1 in. from heater
0 to 100 = 20 mu
1 Feb


0
146 °F
2.6
178 °F
3.4
298 °F
6.6
409 °F
9.8
10
20
30
40
50
60
70
80
90
.020 Teflon
10
.6
2
.8
020 Teflon
1 in. from heater
0 to 100 = 20 MV


.020 TEFLON
MATERIAL: TEFLON .020
HEAT SOURCE
1" FROM HEAT SOURCE
1.020 FROM HEAT SOURCE
1-1/4" FROM HEAT SOURCE
600
575
550
525
500
475
450
425
400
375
350
325
300
275
250
225
200
175
150
125
DEGREE F
1
2
3
4
5
6
7
8
9
10
TIME (MINUTES)


.020 TEFLON
600
575
550
525
500
475
450
425
400
375
350
325
300
275
250
225
200
175
150
125
DEGREE F
MATERIAL: TEFLON .020
HEAT SOURCE
1" FROM HEAT SOURCE
1.020 FROM HEAT SOURCE
1-1/4" FROM HEAT SOURCE
1
2
3
4
5
6
7
8
9
10
TIME (MINUTES)


0.20 TEFLON
MATERIAL: TEFLON .020
HEAT SOURCE
1/2" FROM HEAT SOURCE
.520 FROM HEAT SOURCE
3/4" FROM HEAT SOURCE
DEGREE F
600
575
550
525
500
475
450
425
400
375
350
325
300
275
250
225
200
175
150
125
1
2
3
4
5
6
7
8
9
10
TIME (MINUTES)


.020 TEFLON
600
575
550
525
500
475
450
425
400
375
350
325
300
275
250
225
200
175
150
125
DEGREE F
MATERIAL: TEFLON .020
HEAT SOURCE
1/2" FROM HEAT SOURCE
.520 FROM HEAT SOURCE
3/4" FROM HEAT SOURCE
1
2
3
4
5
6
7
8
9
10
TIME (MINUTES)

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-46

RWF	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Environmental Testing of Tape Recorder and D.C. Control

Date of Test: March, 1962

Requested by: R. W. Forsythe

Performed by: Peterson & King

Purpose of Test: To determine final environmental flight acceptance.

Description of Article Tested (Photographs, if any):

Tape Recorder and D.C. Control for prototype. Flight Unit #1, and Flight Unit #2.

Test Equipment (Photographs, if any):

CVC Vacuum Chamber
Minneapolis Honeywell Temperature Recorder.

Test Procedure:

The tape recorder and D.C. control unit were mounted on the refrigeration coil unit in the CVC vacuum chamber. Temperature and pressure in the chamber were varied and the tape recorder and D.C. control unit were checked out by the P.T. Cole group at the points shown in his records.

Results:

The tape recorder and D.C. control passed all acceptance tests required. The test records were retained by P. T. Cole.

Conclusions:

FLY IT!

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

File No. 500-25

CLW	P.E.
JTS	S.H.
RCB	B.H.

INFORMAL TEST REPORT

Name of Test: Timer Adjustment

Date of Test: 30 Jan. 1962

Requested by: Carl Wagner

Performed by: P. King & J. Schaefer

Purpose of Test: Timer Calibration.

Description of Article Tested (Photographs, if any):

2 Raymond Timers
Ser. Nos. 5152E
5151E

See Photo #1 – Raymond Timers

Test Equipment (Photographs, if any):

Stop Watches
Ohmmeter

Test Procedure:

Checked time, from moment of timer actuation of five microswitches in each timer, to close.

Results:

See Data Sheet.

Conclusions:

Timers are of no use for S-51 in their present state! Pete will try to bring timers to closer adjustment.

C.L.W.

SHEET_____

Switch Number	T_0 Opens	T_1 Closes	T_2 Closes	T_3 Closes	T_4 Closes	Run Number				
1	25.8	926.8	985.8	1051.6	1117.8	1				
1	25.4	915.8	974.6	1037.0	1101.0	2	SER. NO. 5152E			
1	25.4	907.6	966.0	1029.8	1094.2	3				
1	24.8	913.0	971.8	1035.4	1099.4	4				
1	25.8	903.3	961.3	1024.6	1087.0	5				
2	27.5	935.0	996.0	1057.8	1122.0	1				
2	26.4	906.2	968.7	1032.4	1097.2	2				
2	26.8	959.3	1025.3	1090.8	1158.6	3				
2	26.8	896.0	957.6	1020.1	1085.5	4	SER. NO. 5151E			
2	30.5	908.8	971.0	1033.7	1098.7	5				
			ALL TIMES ARE IN SECONDS							

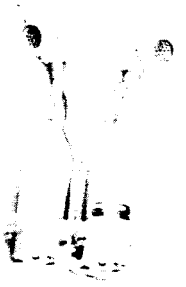


Photo #1 – Raymond Timers

MECHANICAL SYSTEMS BRANCH
SPACECRAFT TECHNOLOGY DIVISION

INFORMAL TEST REPORT

File No. 500-42	
FWK-CLW	P.E.
JTS	S.H.
B/CLW	B.H.

Name of Test: Temp.-Load Deformation Of Outside Skin Of X-248 Bottle

Date of Test: 5 & 6 July '62

Requested by: Carl Wagner

Performed by: F. N. LeDoux, J. Wall

Purpose of Test: To determine if heat and load would cause a great enough deflection to cause nylon cord to release early.

Description of Article Tested (Photographs, if any):

Circular segment of fiberglass comparable to that on outside skin of X-248.

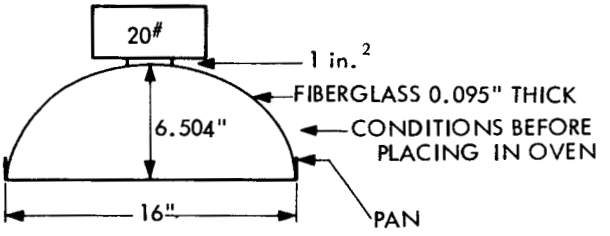
Test Equipment (Photographs, if any):

Blue M Oven
20# Lead Weight
Inside Calipers
Micrometer 6" - 7"

Test Procedure:

1. Temp. in oven was 405°F before set-up was placed in oven.
2. When we put fixture in oven, temp. dropped to 329°F.
3. Fixture was in oven for a total of 45 minutes.
4. Heighth measured after 15 minutes and 45 minutes.
5. Fixture was removed from oven after 45 minutes.

See Photo #1.



Results:

Load = 20#/in

Time	Temp.
0 ———	-329°F*
5 - - -	No Read
10 - - -	354°F
15 - - -	360°F**
20 - - -	No Read
25 - - -	No Read
30 - - -	370°F
35 - - -	374°F
40 - - -	No Read
45 - - -	383°F

*Temp. dropped from preheated 405°F to 329°F while we put in fixture.

**Temp. dropped from 360°F at end of first 15 min. to 338 to start next 30 minutes while we measured height.

Before heat - 6.504"
After 15 min. - 6.481"

.023" = change during 15 min.

After 45 min. - 6.479"

.025" = change during 45 min.

Conclusions:

Deformation of an elliptical spring varies as the thickness cubed, thus a .055" thick wall might deflect .129" if a constant loading were applied. This would, however, decrease the tension on the string from 60# to 35#, which is still more than enough to prevent spring from pulling string (cord) from saddles to release booms.

Consider the supports for pin-pullers which cause greater loads on the skin - deformation might be as much as .35 inches. CLW

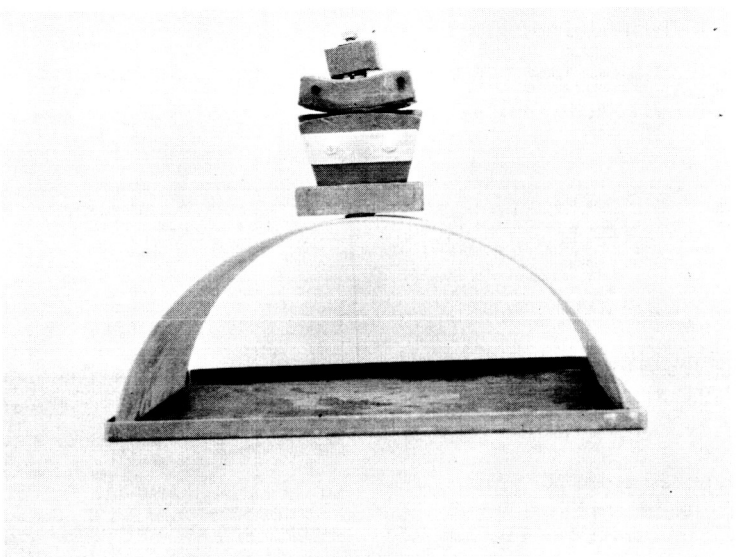
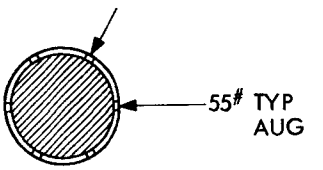


Photo No. 1

Comparison – X-248 Bottle vs.
Temp.-Load Test of Fiberglass Half-Cyl.

	Bottle	Test Specimen
Loading (lb.)	55	20
Diameter (in.)	18	15
Thickness (in.)	.055	.095
Deflection (in.)	?	.025

There are (4) half-moons & (2) pin-pullers on the X-248 bottle



In use the cords were each stretched from 28-29" to ~ 31" to get the required tension. With the (2) cords, we have a total change in length of:

$$\begin{array}{r} (2)(31) = 62" \\ -(2)(28.5) = 57" \\ \hline 5" \end{array}$$

So the cord would have to slacken by 5" before the tension drop would go to 0#.

Now consider the deflection of the test specimen of .025"/20# loading,

Load Factor $L = 55/20 = 2.75$
Dia. Factor $D = 18/15 = 1.3$
Thickness Factor $t = .095/.055 = 1.7$

$$\delta(\text{Deflection of Bottle}) = (.025")(2.8)(1.3)(1.7)$$
$$\delta = .154"$$

On a Dia., we have $(2)(.154") \cong .31"$ giving a total cord length change (considering the cord wrapped circular)

$$\pi(\text{Starting Length} - \text{Finish L.}) = \text{Change in Length}$$

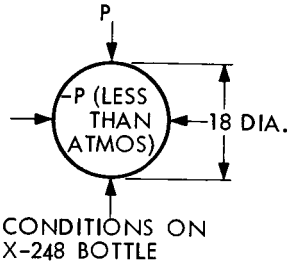
$$\pi\,[18-(18.-.31)] = 56.5-55.5$$
$$= 1." \text{ Length Change}$$

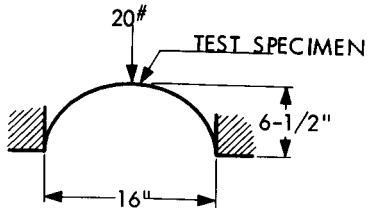
This does not reach the required length to give "0" tension. Furthermore, while the bottle is spin stabilized the booms have a centrifugal force acting on them which adds to the tension in the cord so "0#" would never be seen by the cord.

ANALYSES:

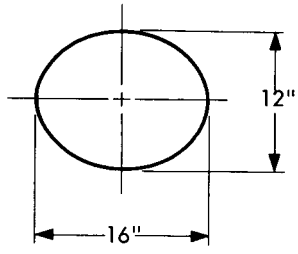
Temp.-Load Deformation of Fibreglass (X-248 Bottle Simulation) Test

#1.





NOTE: The test specimen has the shape of half an ellipse which would have,



CONCLUSION: The test would be invalid since the basic rigidity of the circular cylinder is lost with the elliptical shape of the half-cylinder tested.

#2. The Fibreglass half-cylinder was subjected to a max. temp. after 45 minutes of 383°F.

Reference: Johns-Manville. "Fibreglass Reinforcement For Plastics" M.S.B. Library #933. "There is no loss in physical properties of Fibreglass up to approximately 500°F." (cf. next page).

CONCLUSION: The test gave little indication of heat effects since the 383°F reached could not have affected the Fibreglass (cf. J.M.).

SUGGESTIONS ON FUTURE:

1. Higher temp. limits (500°F range)
2. Restraining ends of the half-cylinder to maintain circular cylinder-type rigidity.

Lamtex Industries, Inc. gives for Fibreglass temp. range -80°F to 400°F.